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ABSTRACT

This report presents empirical evidence about the impact that capital investment has on academic achievement in the United Kingdom public school system. It also provides an overview of the research methodology and the main findings from the existing literature and qualitative studies compared to those found in quantitative studies. Analyses indicates that, while most quantitative studies show that capital spending heightens academic performance, the relationship appears weak. However, qualitative studies and a literature review reveal a stronger link between capital spending and student achievement. The strongest relationship between capital investment and academic performance appears to be in specific school design features and school facility quality. Appendices contain additional information on the qualitative research design, issues related to the study's statistical methodology, and detailed statistical results. (Contains 54 references.) (GR)

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ED 461 980

Research Report
No. 242

D/EE

# *Building Performance*

## An empirical assessment of the relationship between schools capital investment and pupil performance

*PricewaterhouseCoopers*

Full text available at:
http://www.dfee.gov.uk/research/
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# Glossary of terms

| | |
|---|---|
| CAD | Computer Aided Design |
| CSR | Comprehensive Spending Review |
| CTC | City Technology College |
| DfEE | Department for Education and Employment |
| FAS | Funding Agency for Schools |
| FSM | Free School Meals |
| GM | Grant Maintained |
| ICT | Information and Communications Technologies |
| KS1 | Key Stage 1 |
| KS2 | Key Stage 2 |
| KS3 | Key Stage 3 |
| LEA | Local Education Authority |
| NDS | New Deal for Schools |
| OfSTED | Office for Standards in Education |
| OLS | Ordinary Least Squares |
| PPP | Public Private Partnerships |
| VA | Voluntary Aided |
| VC | Voluntary Controlled |

# Section I
# Introduction

Recent reports from the Office for Standards in Education (OfSTED) have stated that as many as 1 in 5 schools in England has accommodation that is in such an unsatisfactory state that the delivery of the curriculum is affected. This reflects a prolonged period of what has generally been acknowledged to be insufficient investment in the sector's capital stock. In 1996-97 annual capital investment was £683m for a capital stock with an approximate replacement cost, excluding land, of £60bn (representing 5% of total public spending on schools). This level of expenditure has proved to be insufficient to maintain the stock at its existing level, and has certainly not allowed for steps to be taken to improve the situation.

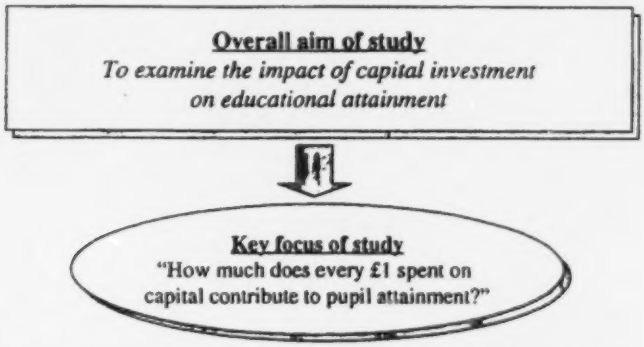
Until recently, capital expenditure for maintained schools in England has been made available primarily through the following routes:

- central government support for local authority capital expenditure via "credit approvals";
- grants to voluntary aided schools to cover 85% of the cost of the governing bodies' responsibilities for capital expenditure;
- the use of local authority receipts from asset disposals and revenue transfers.

Historically, expenditure through these routes has been focused on ensuring that there is a sufficient supply of places for all children to be educated, rather than on ensuring that the premises in which they are being educated are in a good condition and "fit for purpose". In the current parliament, additional funding routes for investment in schools capital have been opened up. The principal elements of the additional funding are:

- the New Deal for Schools - £1.3bn to address the worst examples of the repairs backlog;
- the Comprehensive Spending Review (1999 – 2002) – an additional £1.5bn made available for schools capital;
- public private partnerships in schools - £1.3bn.

Within this context, the Department for Education and Employment (DfEE) commissioned a major study to examine the relationship between capital investment in schools, and subsequent academic attainment. The study was conducted between September 1999 and March 2000 by PricewaterhouseCoopers. The key purpose of the study was to provide an empirical analysis of the impact of capital investment on educational attainment. In particular, a key objective of the study was to establish, if possible, the additional effect in terms of pupil attainment of every £1 invested in schools capital (see figure overleaf).


Overall aim of study
To examine the impact of capital investment on educational attainment
Key focus of study
"How much does every £1 spent on capital contribute to pupil attainment?"

In order to address these objectives, three main strands of work were undertaken:

- a review of existing literature on the links between capital spending and pupil performance;
- a qualitative stream of work involving visits to 27 schools;
- a quantitative stream of work which involved conducting a statistical analysis of information on capital investment and pupil performance in 1,916 English schools.

This Report outlines the main findings from the study, and is structured as follows:

- **Section II: Methodology:** this provides an overview of the methodology adopted in each of the three main strands of research;
- **Section III: Literature review:** this presents the main findings from our review of existing literature;
- **Section IV: Qualitative analysis:** this presents the findings from the qualitative research with headteachers and other stakeholders;
- **Section V: Quantitative analysis:** this presents the findings from the statistical analysis of quantitative data relating to capital spending and pupil performance in England;
- **Section VI: Conclusions:** this provides an overview of the main findings from each of the three research strands, and provides some suggestions for further research.

# Section II
# Methodology

## Introduction

This section provides an overview of the methodology used in the study.

As outlined above, the study involved three main strands of work, namely a literature review, a qualitative analysis and a quantitative analysis. By way of summary, a brief description of the methodology for each of these research strands is provided in the table below. More detailed information on a range of methodological issues is provided in Appendices A (qualitative analysis) and B (quantitative analysis).

| **Literature review** |
|---|
| • Review covered 54 separate studies from the UK, US and elsewhere;<br>• Wide range of studies included, e.g. quantitative and qualitative studies; academic and non-academic studies;<br>• Studies from a range of disciplines, e.g. economics, sociology, architecture. |
| **Qualitative analysis** |
| • Interviews covered 5 Local Education Authorities (LEAs):<br>– 27 headteachers;<br>– 4 LEA officials;<br>– 2 Diocesan authority representatives;<br>– 2 former staff of Funding Agency for Schools. |
| **Quantitative analysis** |
| • Database contained information on 1,916 primary and secondary schools;<br>• Range of statistical/econometric techniques used, e.g. bivariate correlation coefficients, OLS, logistic regression;<br>• Analysis 'controlled for' effects of other factors, e.g. Free School Meals (FSM), school type, leadership. |

## Literature review

In total 54 studies were reviewed, most of which had been conducted in the US. A full list of references is provided in the Bibliography of this Report. The approach included as wide a range of studies as possible, i.e. studies from different disciplines (e.g. economics, sociology, architecture), and studies which adopted different methodological approaches (e.g. statistically based quantitative analysis, as well as studies of a more qualitative nature).

## Qualitative analysis

### *Design of 'conceptual model'*

An important first stage of the qualitative research involved designing a 'conceptual model' which outlined the main factors influencing pupil attainment, both directly and indirectly. Such factors included, for example, the quality of teacher training, class size, school policy on homework, prior pupil attainment and pupil motivation. The conceptual model provided a framework within which the impact of schools capital on pupil attainment could be assessed. In doing so, it was also used to help design the topic list for the interviews with the headteachers.

### *Selection of LEAs and schools*[1]

The majority of the qualitative analysis was concentrated in four LEAs. These LEAs were selected to include those which were large and small, urban and rural, in different regions across the country, in areas of high and low deprivation, and with high and low concentrations of ethnic minorities (see table below).

**Characteristics of LEAs selected for qualitative fieldwork**

| | Size | Urban/ Rural | Location | Social deprivation | Ethnic minority share |
|---|---|---|---|---|---|
| LEA 1 | Large | Rural | Midlands | Low | Low |
| LEA 2 | Large | Urban | Midlands | High | High |
| LEA 3 | Large | Mixed | North | Average | Medium |
| LEA 4 | Small | Urban | South | High | High |

Once the LEAs had been selected, interviews were conducted with LEA officials in order to identify schools which had had significant capital expenditure in the last five years on building works in a range of categories[2]. Primary and Secondary schools (including 'specialist' schools) were selected, as well as Community, Voluntary and Foundation schools. LEAs were asked to include, if possible, schools which OfSTED had identified as being very successful, as well as those which are less successful.

Schools were also selected on the basis of the particular type of capital investment which had been undertaken. In this regard, three broad categories were used:

- **Sufficiency:** basic need, i.e. provision of school places;
- **Condition:** like-for-like replacement, e.g. installation of new windows or roofs, replacement of dilapidated accommodation;
- **Suitability:** improvement works, e.g. construction of new science block

[1] Special schools were excluded from the analysis given that the main focus of the study was on the relationship between capital and conventional measures of pupil performance.

[2] In addition to the interviews with LEA officials, interviews were also conducted with Diocesan authority representatives and former staff of the Funding Agency for Schools.

The table overleaf provides an overview of the characteristics of the schools, as well as the type of capital expenditure which had been undertaken.

**Characteristics of schools selected for qualitative fieldwork**

| School | Primary | Secondary | Former County | Voluntary | Former GM | CTC | 'Sufficiency' | 'Condition' | 'Suitability' |
|---|---|---|---|---|---|---|---|---|---|
| 1 | ✔ | | | ✔ | | | | ✔ | |
| 2 | ✔ | | | ✔ | | | | ✔ | |
| 3 | | ✔ | ✔ | | | | ✔ | | ✔ |
| 4 | | ✔ | ✔ | | | | ✔ | | |
| 5 | | ✔ | ✔ | | | | | ✔ | |
| 6 | | ✔ | | | ✔ | | ✔ | | ✔ |
| 7 | | ✔ | | | ✔ | | | ✔ | |
| 8 | | ✔ | ✔ | | | | ✔ | | |
| 9 | ✔ | | ✔ | | | | | ✔ | ✔ |
| 10 | ✔ | | | ✔ | | | | ✔ | ✔ |
| 11 | | ✔ | ✔ | | | | ✔ | ✔ | ✔ |
| 12 | | ✔ | ✔ | | | | ✔ | ✔ | ✔ |
| 13 | ✔ | | ✔ | | | | ✔ | ✔ | ✔ |
| 14 | ✔ | | ✔ | | | | ✔ | ✔ | ✔ |
| 15 | | ✔ | | | ✔ | | ✔ | ✔ | ✔ |
| 16 | ✔ | | ✔ | | | | | ✔ | ✔ |
| 17 | ✔ | | ✔ | | | | ✔ | | |
| 18 | ✔ | | ✔ | | | | ✔ | | |
| 19 | | ✔ | ✔ | | | | | ✔ | ✔ |
| 20 | | ✔ | ✔ | | | | | ✔ | ✔ |
| 21 | | ✔ | | | | ✔ | | | ✔ |
| 22 | | ✔ | | | ✔ | | | ✔ | ✔ |
| 23 | | ✔ | | | ✔ | | | ✔ | ✔ |
| 24 | | ✔ | | | ✔ | | | ✔ | ✔ |
| 25 | | ✔ | | | ✔ | | ✔ | | ✔ |
| 26 | | ✔ | | | ✔ | | ✔ | | ✔ |
| 27 | | ✔ | | | ✔ | | | ✔ | ✔ |

### *Interviews with headteachers*

Structured face-to-face interviews were conducted with headteachers in the schools. On average, the interviews lasted between two and three hours. The interviews were structured around a detailed topic list (see Appendix A) containing questions under two main headings:

- **Factors influencing attainment:** a detailed discussion was conducted of the factors which the headteachers believed most influenced the educational achievements of pupils at their schools;

- **Factors influenced by capital:** headteachers were also asked to consider how – if at all – capital spending influences a range of 'intermediate' factors which had been identified previously in the conceptual model. They were asked to give examples to display the mechanism by which capital influences pupil attainment, and to judge the strength of influence which capital has upon each factor.

## Quantitative analysis

### *Construction of database*

A large-scale database was constructed containing information on 1,916 English schools (see table below). Around one half of both primary and secondary schools had some form of capital expenditure over the period 1993-95. The database contained a good representation of schools throughout England (e.g. in terms of school type, geographical location, school size and socio-economic composition).

**Number of schools on database**

| | Primary | Secondary | All |
|---|---|---|---|
| All | 940 | 976 | 1,916 |
| Schools with *some* capital expenditure | 458 | 567 | 1,025 |
| Schools with *no* capital expenditure | 482 | 409 | 891 |
| VA | 389 | 147 | 436 |
| GM | 150 | 405 | 555 |
| Community | 401 | 424 | 825 |

### *Information contained on the database*

A detailed description of the type of information contained in the database is provided in section V of this report. By way of summary, the database contained information on the nature and extent of capital investment in each of the schools, in particular, the overall quality of the capital stock in each school, and the amount of spending on capital between 1993 and 1995. The database also contained information on changes in pupil performance between 1995 and 1999 at five main levels, namely Key Stages 1, 2 and 3, GCSE and A Level. In addition, the database contained information on a range of other factors such as school type and size, school selection policy, Free School Meals (FSM), the quality of teaching staff and leadership.

### *Statistical analysis*

Given the complexity of the issue, a wide range of statistical techniques were used in order to provide a balanced and holistic interpretation of the relationships between key factors. Three main levels (or 'stages') were used in the statistical analysis:

- **Stage 1 - Descriptive analysis:** this provided a statistical overview of the key features of the data in relation to the two main indicators of capital investment, namely capital spending and the adequacy of accommodation.

This was done mainly using simple descriptive statistics, e.g. standard deviations, means etc;

- **Stage 2 - Correlation analysis:** this provided a detailed analysis of the *correlations* which exist between capital investment and pupil performance. This was done mainly using simple correlation coefficients (e.g. Spearman's, and Pearson's) and cross-tabulations. Aggregate correlations were conducted for all the schools on the dataset. In addition, disaggregate correlations were also conducted, i.e. for certain types of school, or school size etc;

- **Stage 3 - Multivariate analysis:** this stage investigated the causal relationships between capital spend and pupil performance. In particular, the multivariate analysis was used to estimate the impact of capital on performance, whilst simultaneously 'controlling for' a range of related factors (e.g. school type, socio-economic background of pupils etc). Our multivariate models were mostly linear regression models (i.e. Ordinary Least Squares), but some non-linear models were also used (e.g. Probits and Logits).

A more detailed discussion of the particular types of statistical models used in the analysis is provided in section V of this report.

# Section III
# Literature review

## Introduction

This section reviews a number of existing studies which have examined the relationship between capital investment in schools and pupil performance. The focus is on whether or not, on balance, existing studies have found a positive and significant relationship to exist between capital spending and pupil performance. The majority of existing research in this field has taken place in the US and, although there are some studies from the UK and elsewhere, it is largely the US literature that is discussed here. The primary outcome of interest is examination performance, although there is also some discussion of alternative measures of pupil performance (e.g. future earnings, staying on rates etc).

The broad structure of this section is as follows:

- **Economic studies of resources and attainment:** this discusses the considerable economics literature on school resources and pupil performance. Although the majority of this literature is concerned with indicators of *total* spending in schools (i.e. not just spending on capital), a number of studies focus directly on the relationship between spending on capital and pupil performance;

- **Studies of school effectiveness and improvement:** this discusses the education/sociology literature on the factors which influence school effectiveness and school improvement. This literature is concerned with identifying the full range of factors which influence school performance (e.g. teaching quality, leadership, curriculum etc). Some of these studies have examined the impact of capital-related variables on pupil performance;

- **Studies of building conditions and design:** this discusses the architectural literature which examines the links between building condition, building design and outcomes in schools. These studies tend to be quantitatively rather less sophisticated than the other studies but, in spite of this, they contain important evidence on the relationship between capital and performance.

## Economic studies of resources and attainment

### *School resources and academic attainment*

In terms of the link between overall school resources (i.e. total spending) and academic attainment, the results of the literature can best be described as 'ambiguous'. Some US studies find positive effects of general resource measures on attainment (e.g. Boardman et al, 1977; Card & Krueger, 1992; Goldhaber & Brewer, 1998). On the other hand, recent UK studies have tended to find no significant effects (e.g. Bradley & Taylor, 1999; Dustman et al, 1998; Feinstein & Symons, 1999). An exception is Bradley et al (1999), which finds that spending on teachers has a positive impact on performance and attendance, albeit small.

Hanushek (1986), (1996b) and Card and Krueger (1996), (1998) provide surveys of this empirical literature and come to the same overall conclusion, i.e. that the findings are rather ambiguous with respect to the effects of school resources on pupil attainment.[3] One possible explanation for the ambiguity is that schools might not use their resources efficiently, and this would obscure any potential relationship (Hanushek, 1996a). Another explanation is that the data are insufficiently accurate, and the techniques insufficiently developed, to identify any relationship (Bradley and Taylor, 1998).

### *School resources and subsequent labour market experience*

Hanushek (1996b), Betts (1996) and Card and Krueger (1996) review the evidence linking school resources with future earnings of pupils, which is again mixed. Card & Krueger (1996) argue that the bulk of evidence points to a positive effect of school expenditure on earnings, for given level of educational attainment (schooling grade reached). In other words, the payoff to another year of education is higher for those in resource-intensive schools.

Consistent with this is a recent UK study which finds that educational expenditure has a significant positive impact on subsequent experiences of education and employment (Dolton et al, 1999). In particular, this study found that in those Local Education Authorities where relatively more is spent (per pupil) on education, individuals tend to be significantly less likely to be outside education and employment after leaving school. It is important to note, however, that Heckman et al (1996), Harmon & Walker (1997) and Betts (1996) find no significant school resource effects on earnings.

### *School resources and staying-on*

Card & Krueger (1996) note that some students will attend school longer the higher the quality of the school. This may be because resource-intensive schools offer a more pleasant environment, or because students know there might be a higher payoff to staying on at a high quality school. They find a strong positive correlation between measures of expenditure and post-compulsory years of schooling for the North/South Carolina 'natural experiment'. They also find evidence of such a relationship at an aggregate level (Card & Krueger, 1992).

Direct studies of the effects of resources on staying-on in the UK are rare, but Dustman et al. (1998) find a robust positive effect of spending on staying-on for a micro level UK sample. Cheng (1995), on the other hand, finds no significant resource effects on staying-on, using the Youth Cohort Study. McVicar (1999) finds a positive expenditure per pupil effect, but a negative teacher-pupil ratio effect with micro level data for Northern Ireland.

### *Capital spending and pupil performance*

Hanushek (1997) presents a meta-analytical survey of the capital expenditure / performance relationship and finds, of 91 separate estimates of the relationship, 9 to be positive and statistically significant and 5 to be negative and statistically significant (see figure below). The majority of the estimated relationships are found to be statistically insignificant. Therefore, *as with school resources generally*, the economics literature provides little firm evidence of a positive relationship between capital investment and performance.

---

[3] Some studies have even found what seem to be *negative* effects on attainment. These are reviewed in the above surveys. It is argued that this is likely to be a result of the endogeneity of class sizes, because less able children are put in smaller classes. Aggregating teacher-pupil ratios to school level helps to reduce this endogeneity problem (Dustman et al, 1998). However, where schools are selective, or intakes are heterogeneous, even school level teacher-pupil ratios are likely to be negatively correlated with academic ability.

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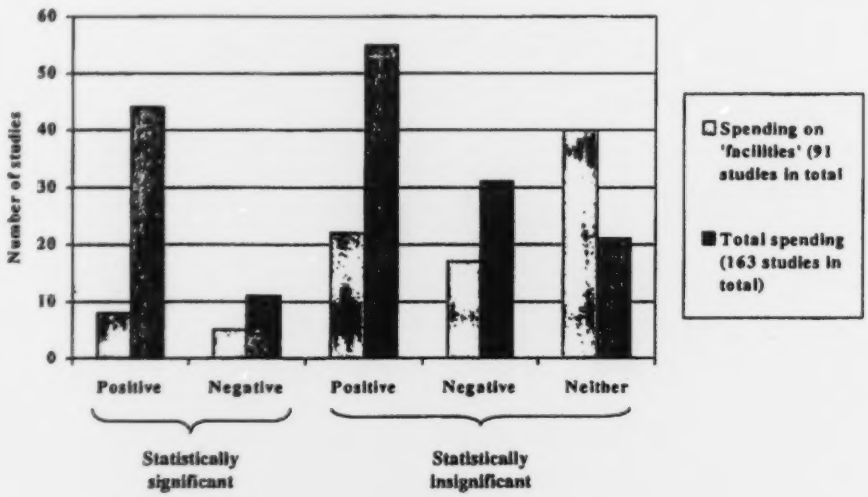
**Summary of Hanushek's 'meta analysis'**




## Studies of school effectiveness and improvement

There is some evidence from the school effectiveness / improvement literature on the link between resources and performance, and more specifically on capital investment and school environment and performance. In the 1960s and 1970s the broad consensus in this literature was that 'schools don't matter' and that individual and family background factors were key (e.g. Burstall, 1979). However, this consensus has been seriously challenged in the last twenty years, and a wide range of other factors have been identified which have a significant impact on pupil performance. An overview of some of these factors is provided in the table below.

**Summary of factors contributing to school effectiveness**

| | |
|---|---|
| **Professional leadership** | • firm & purposeful<br>• participative approach |
| **Shared vision & goals** | • unity of purpose<br>• consistency of practice<br>• collegiality & collaboration |
| **Learning environment** | • attractive working environment<br>• orderly atmosphere |
| **Concentration on teaching & learning** | • maximisation of learning time<br>• focus on achievement |
| **Purposeful teaching** | • efficient organisation<br>• clarity of purpose<br>• adaptive practice |
| **Other factors** | • high expectations<br>• positive reinforcement<br>• monitoring progress<br>• pupils' rights & responsibilities<br>• home-school partnerships<br>• staff development |

*Note: This table is based on Sammons et al, 1995, p8.*

In terms of capital expenditure, Rutter et al (1979) found building conditions to be an important factor in pupil performance. Subsequently, similar evidence has been found by numerous other studies in this literature (e.g. Chubb, 1988; Mortimore, 1991, 1993; Mortimore et al., 1988; Berner, 1993). Also in this vein of research, Lezote (1989) argues that a 'safe and orderly environment' is good for pupil performance.

Other studies in this literature have examined the intermediate outcomes which underpin the performance/capital relationship, such as teacher morale. The findings of this body of research generally support and provide explanations for the pupil performance effects found by the above studies. Corcoran et al (1988) find that poor building conditions lead to higher teacher absenteeism, higher job-flow, lower job-satisfaction and lower effort. Poplin and Weeres (1992) argue that a depressed physical environment is believed by pupils to reflect society's lack of priority for their education and is therefore detrimental to morale and effort.

## Studies of building condition and design

There are a large number of studies in the architecture literature which have examined the impact of school buildings and educational outcomes, primarily in the US. For example, some cross-sectional studies have examined the relationships between performance and particular physical characteristics across schools. There are also some US studies that compare exam performance and broad measures of building quality (or building age) across schools.

Examples of specific factors that have been found to have a significant effect on performance include heating (e.g. McGuffy, 1982; Lowe, 1990), air quality (Andrews and Neuroth, 1988), air conditioning (Lanham, 1999), daylighting (Peyton, 1999) and noise levels (e.g. Duke, 1998). Much of this research has proved valuable in improving aspects of the design of new buildings (Earthman, 1998). However, it is important to note that these particular factors are not consistently significant in all such studies, and neither does such research prove the existence of a more general relationship between capital expenditure and performance.

Examples of studies where positive relationships between general building conditions and performance have been identified are Bowers et al. (1987), Edwards (1992), Cash (1993), and Hines (1996). The difference between test scores in standard and sub-standard school buildings suggested by these studies ranges from 5 to 17%. Maxwell (1998) provides more robust evidence from a longitudinal study in the US, in which exam performances were compared across schools in a particular city before and after renovations. The results suggested that performance improved after renovations, although the effects were not always statistically significant. Unsurprisingly, performance dropped *during* renovations. Some studies also find evidence of a positive link between building condition and the more intermediate outcome of pupil behaviour (e.g. Earthman et al, 1995).[4]

Reviews of the building condition literature are provided by McGuffy (1982) and Earthman and Lemasters (1996). Both surveys conclude that the evidence points to a positive relationship. However, the studies reviewed are generally highly vulnerable to the criticism of omitted and difficult-to-measure variables, although some efforts are made to incorporate school level socio-economic factors with free school meals measures, for example. A longitudinal (panel) data approach would reduce this problem and also allow the lagged nature of any capital effects to be examined (Earthman, 1998). From this perspective, the Maxwell (1998) study provides the strongest evidence.

[4] There is a possibility of reverse causality in such studies, where badly behaved pupils may be more likely to damage school infrastructure (Garcia de Paredes, 1998).

## Conclusions

By way of summary, the key findings to emerge from this review are as follows:

- there are three broad strands of literature that examine the relationship between capital investment and pupil performance in schools: an economics literature, a school effectiveness (education/sociology) literature and an architectural building design literature;

- the economics literature is mostly concerned with school resources in general, and not specifically capital investment. Evidence for a relationship between *general resources* and performance could be described as *'far from overwhelming'*; some studies find a positive relationship, some find a negative relationship, and others find no relationship at all;

- the relatively small economics literature which focuses specifically on capital investment also draws mixed conclusions. The evidence is uncertain for modern advanced economies, although a stronger relationship has been found in developing countries and historically in developed countries. As part of this research, no quantitative economics studies have been found which focus specifically on capital investment and pupil performance for the UK;

- the school effectiveness / improvement literature provides some evidence of a positive relationship, although this has to be seen within the context of a wide range of other factors which impact on performance (e.g. leadership, teaching quality etc); *'necessary but not sufficient'* is perhaps the best way of describing the findings of this literature in relation to capital spend. In fact, the strongest evidence from this literature is in relation to the impact of capital variables on intermediate factors such as teacher morale;

- the architecture literature on school building condition and design generally finds a *positive relationship* between the quality of the physical school environment and pupil performance. However, much of this literature is open to methodological criticism from applied economists, particularly with regard to omitted variables.

Generally speaking, therefore, the estimated impact of capital spending on pupil performance varies according to the broad type of study under consideration. There is, effectively, a spectrum of studies. At one end, there are those studies which find a broadly positive relationship. These tend to be in the architecture literature, and relate to specific design features of schools and the overall quality of school buildings, as opposed to capital spending *per se*. At the other end of the spectrum there are a range of economic studies, the results of which are rather ambiguous with respect to the impact of capital spend on performance. How can these differing results be reconciled? There is considerable scope for further and detailed research into the capital performance relationship to clarify this uncertainty, but it is likely that the answer lies in two key areas:

- **methodological differences:** the general ambiguity of the economics studies is likely to be related, at least in part, to qualitative and methodological differences in the nature of the studies (e.g. model specification, levels of aggregation, data quality, location, time period under consideration etc.);

- **isolating the impact of spending quantity and quality:** the economics studies which have been reviewed above tend to use aggregate measures of the total *amount* of spending. Whilst this is valid, it fails to account for the fact that there may be important qualitative differences in spending which are

not 'picked up' in the quantitative figures. For example, two schools may spend exactly the same amount on capital, but one school may spend it wisely (e.g. on initiatives which improve light, thermal optima or learning times), and the other school may spend it unwisely. Indeed one of the central messages in the studies from the architecture literature is that certain forms of spending, as reflected in design features of buildings, are more effective than others in terms of improving pupil performance.

# Section IV
# Qualitative analysis

## Introduction

This section presents the main findings from the qualitative analysis and, in particular, the interviews with headteachers which sought to identify specific ways in which different forms of capital investment have an impact on pupil performance in individual schools. In addition, the analysis tried to identify all of the key factors which headteachers judged to have an important influence on pupil attainment, and to discuss the inter-relationships which exist between them.

In order to do this, in-depth interviews were conducted with headteachers in 5 separate LEAs throughout England.

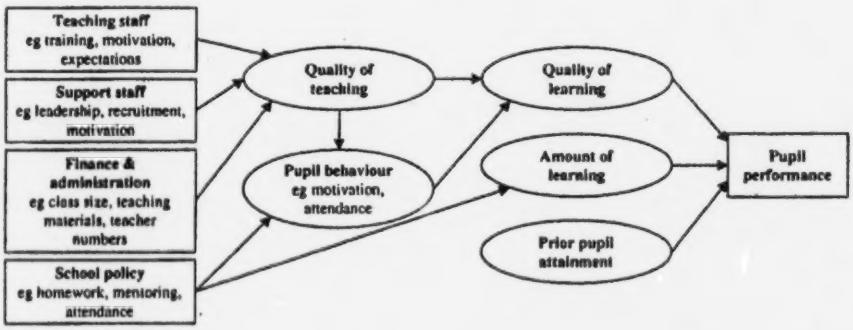
The broad structure of this section is as follows:

- **An overview of the main factors influencing attainment**
- **Capital investment and teacher motivation**
- **Capital investment and pupil motivation**
- **Capital investment and the amount of learning**
- **Other factors affected by capital**
- **Conclusions**

## An overview of the main factors influencing attainment

At the outset of the qualitative research, a conceptual model was designed which set out schematically the main factors influencing pupil attainment. The model was based on the assumption that pupils were studying the National Curriculum, so that curriculum variation was not to be shown as a separate impact upon pupil attainment. The full conceptual model is shown in Appendix A, and a summary of it is provided in the figure overleaf.

**An overview of our conceptual model**




The conceptual model identifies three key factors which affect pupil attainment, namely (a) the quality of pupil learning, (b) the amount of pupil learning and (c) prior pupil attainment. This model was used as a framework for discussing with headteachers the main factors which influence pupil attainment. A number of findings emerged from the discussions with headteachers:

- **General endorsement of conceptual model:** generally speaking, the headteachers who were interviewed agreed with the main factors identified in the conceptual model as influencing attainment. In particular, they agreed that the quality of learning, the amount of learning and prior pupil attainment were three of the main factors which had a direct influence on pupil performance;

- **Fundamental importance of learning quality:** the headteachers indicated that, for pupils with a normal attendance record, the 'quality of learning' had a much stronger impact on pupil attainment than the 'amount of learning' (see box overleaf). When asked to score these two key factors out of 100, the average was 76% for the quality of learning, and 24% for the amount of learning;

- **Links between teaching quality and learning quality:** all of the headteachers, without exception, identified the quality of teaching as being the most significant single intermediate factor affecting the quality of learning and, therefore, pupil attainment;

- **Links between teaching quality and pupil motivation:** a number of headteachers highlighted the interrelationships which exist between the quality of teaching and pupil behaviour. They said that while good teaching affected pupil motivation and therefore behaviour, pupil motivation itself had an impact on teaching quality. Similarly, while teaching quality affected pupil behaviour for the normal range of pupils, 'challenging' pupils whose behaviour was outside the norm, had an adverse impact on teaching quality for the whole class;

- **Differing views in relation to prior pupil attainment:** headteachers held different views about the impact of prior pupil attainment on educational attainment. Some held that this was the most major influence on a pupil's achievement, and that all that the school could achieve was a marginal change from the predetermined position. Others maintained that for the majority of children, what happened in school was by far the strongest influence on an individual pupil's attainment.

***Community Secondary***

The head identified teaching quality as the predominant influence on pupil attainment. This is, in his view, based on initial (and updated) teacher skills further enhanced by high motivation and access to the appropriate teaching resources in appropriate surroundings. Pupil behaviour and motivation are a contributory factor to teaching quality and therefore to effective learning by pupils.

He likened it to acting where an excellent actor can perform anywhere but does so best in a properly designed space with appropriate props and when the audience is receptive. One person's mobile phone going off can ruin a performance for everyone. Similarly pupil motivation and receptiveness is a factor in teacher effectiveness (and vice versa). The motivation of the whole class and the effectiveness of the learning which results can be adversely affected by a single pupil. So pupil behaviour is important not just in the sense of overall avoidance of disorder but in ensuring that lessons are not ruined by what can be small numbers of pupils who are inattentive or lack motivation; this may be sometimes because of home circumstances outside the knowledge or impact of the school.

## Capital investment and teacher motivation

All of the headteachers reported that the building work undertaken at their school had had a major impact on teacher motivation. In some cases, capital investment had been aimed at reducing overcrowding, which had usually been coped with by the use of 'mobile' classrooms. Although these provided basic accommodation, they quickly affected teacher morale and effectiveness adversely. The factors behind this included poor quality teaching environment as the classrooms rotted and leaked, inability to work close to colleagues and to access common materials and equipment, and vulnerability to external vandalism and break-ins.

In other cases the investment had led to the replacement of dilapidated accommodation which would otherwise have had to be taken out of use, or else the general re-modelling of the existing premises.

***Voluntary Aided Primary***

*"The old 19th century building was insecure. This led to vandalism and break-ins. No work or equipment could safely be left out at night. The roof leaked and classrooms had to have standing buckets in them. There was no storage. The rooms were too small and restricted teaching methods. The stone stairs in part of the building had to be constantly monitored to ensure the safety of younger pupils. The new school is warmer and quieter with no stone corridors and stairs. No wonder morale is better!"*

***Community Secondary***

*"There was a considerable effect on teacher morale. The quality of working environment gives strong visual messages. It tells people what you think of them. People believe what they see and experience rather than weasel words. Poor buildings say that you don't have a value in the system".*

***Community Primary***

*"Happiness and calm were found in an empathetic environment which was said by the head to have made teachers proud of their surroundings. Teachers were observed willingly spending much more time after school in their classrooms. Teachers found coping with the frequent periods of building work stressful but were greatly motivated by the result."*

In many instances the re-modelling work had to be carried out in a working school. This disrupted classes, and in some instances was noted to have actually lowered teacher morale. However, this was identified as being a short term effect, the longer term effects being strongly positive.

***Community Secondary***

A very marked effect on morale was observed. There was some adverse effect as the re-modelling was taking place. This involved classes being taught in dining halls instead of specialist rooms for a time. But the adverse effect on morale then has been vastly outweighed by their pride in the new facilities and the effect this has had on their ability to deliver a programme of teaching in a style they consider professionally desirable.

The new building allowed staff to change the way in which subjects are taught. For example, although there was an electronics laboratory, it was isolated from the other technology rooms and so spontaneous use of it during project work was not possible. Now it is adjacent to the other areas and separated by a window. This means pupils can work in – say – a welding area and then move into electronics as and when their work demands it. This encourages teachers to adopt best teaching practices and in doing so raises their morale as these obstacles to their professionalism are removed.

There has been no reduction in morale as time has passed and staff have grown used to the new facilities.

***Community Primary***

Teachers were in old former army huts which leaked, were cold and vulnerable to damage. They had little incentive to stay after school in such surroundings. Now they have to be turned off the premises by the caretaker!

Foundation schools used formula capital allocations to improve the suitability of the school accommodation. These schools had been able to make plans to use capital expenditure which they knew they would receive annually. This was in marked contrast to other categories of school where the LEA (or the Diocese) had made bids on the school's behalf to DfEE. In such cases the school had had no inkling of the likelihood of success of the bid and so could not plan on the basis of certainty.

***Foundation Secondary***

*"The impact on motivation and quality of teaching has been huge with the greatest lift coming, paradoxically, from the small scale rationalisations of accommodation rather than the big capital projects."*

These small capital allocations were seen by all Foundation schools as having very powerful effects on teacher motivation. Pinch points involving minor expenditure could be addressed in a planned cycle so that departments could see that their turn would come in due course. In addition such projects invited close involvement of the teachers in their planning and implementation which was considered an additional impetus to improved motivation.

Generally, therefore, capital investment was seen by headteachers as one of the most powerful levers on teacher motivation, mainly through the boost to morale which teachers get from working in an appropriate and quality physical environment.

## Capital investment and pupil motivation

Headteachers viewed capital investment as having a strong positive impact on pupil behaviour and motivation. In the case of secondary schools, they reported that new facilities excited the interest of pupils. One headteacher reported that towards the end of the summer term pupils regularly ask if they will be timetabled in the 'new' science labs next year, and are disappointed if they have to use the 'old' facilities. These 'new' laboratories have now been in use over 6 years! Headteachers reported that pupils care about the facilities they work in, and this affects their willingness to learn.

Inner city heads in particular observed a close correlation between the quality of the facilities and a sense that education is important, and that pupils are being valued by the system. For potential truants, the comparison can be between the comfort and quality of the school surroundings and those of the local shopping mall; all too often the mall was far superior.

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***Community Secondary***

The new technical facilities (science, technology) have a major impact on the children. Children draw comparisons between what they experience at home and what is on offer at school. They all have their own TVs and videos and an increasing number have PCs. If such equipment is not readily available at school they are turned off. It is rather like the comparison between the home of 1900 and the home of today. What was acceptable then in terms of facilities, space, comforts and equipment is just not acceptable today. Pupils inevitably compare their home lives and school and if school cannot keep up then they are demotivated.

***Community Secondary***

*(A school remodelled as part of removing surplus places).*

*"In an age when visual signs are much stronger than verbal ones they had to have visible proof – rather than just words – to show that we care about them. They were in wrecked buildings at home and at school. The school leaked, was draughty, was insecure and vandalised. Outside there was crime, danger and poverty and poor housing in a damaged environment. Now the housing and environment have been upgraded, the school is shiny new and carpeted in the classrooms and has modern facilities and equipment. That has helped to create the preconditions for teaching quality to make an impact – and it has.*

*I see the work as part of the 'social inclusion' agenda. It gave the pupils visible proof that those in charge feel they are worth supporting and worth providing decent facilities for. It enhanced their view of themselves and their potential".*

An important link was also identified between capital investment, pupil motivation and pupil behaviour.

***Community Secondary***

*"A deliberate policy of building in improvements to circulation as an objective for each project so as to cut down on movement and contrary traffic flows has improved behaviour. The better state and location of classrooms has enabled a much wider range of teaching strategies to be used and for these to be tailored so that they minimise behaviour problems in 'difficult" subject areas. Both teaching and learning – and therefore attainment - have benefited from this."*

***Community Secondary***

*"Pupil behaviour was never bad but is easier to maintain particularly as a result of the alterations made to circulation. The original section of the building had corridors and two sets of stairs which gave access to a second storey serving 8 rooms from each separate staircase. These have now been linked up so that pupils go up one staircase and down the other from 16 rooms. This removes the actual danger of jostling on the stairs as well as removing the pretext for misbehaviour."*

***Foundation Secondary***

*"That which is beautiful they don't destroy."*

Headteachers in primary schools saw a somewhat weaker link between capital and pupil motivation, compared to secondary school headteachers. This was explained in terms of younger pupils being less affected by their physical environment than by the relationships they establish with their teachers and other adults in the school. Notwithstanding this, there were a number of specific mechanisms whereby capital did have a positive impact on the motivation and behaviour of children in primary schools.

***Voluntary Aided Primary***

*(Removal of mobile classrooms in use for 10 years.)*

Children in the new classrooms have reacted in a very positive way to the new accommodation and the head expects this effect to be long lasting. The biggest gain has been the greater sense of security felt by the younger children with direct access from their classrooms to their own toilets and playing space.

***Community Primary***

*"The quality of teaching is wasted if the environment is poor. Pupils have been greatly motivated by the surroundings and display pride in them."*

The headteacher is convinced that this has a direct and significant effect on attainment as children in a poor and cluttered environment quickly revert to displacement activities, are distracted from learning and so do less of it.

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## Capital investment and the amount of learning

### *Enhancing the breadth of teaching*

One of the key ways in which capital investment contributed to the amount of learning was through the creation of specialist spaces which the school lacked before, and which had prevented schools from teaching the National Curriculum. Specialist areas related to Science, Technology and Information and Communications Technologies (ICT), were the curriculum areas most frequently quoted by heads as being enhanced by capital expenditure. Other headteachers made reference to improvements in Physical Education brought about by the building of a Sports Hall and to Drama by the creation of a new studio.

***Community Secondary***

*"In addition to the removal of the split site, the school's ability effectively to teach the full range of the National Curriculum requirements was affected in three ways. The expansion to the school incorporated the provision of a suite of science laboratories equipped for modern teaching requirements. The new pottery area enables 3D work to be done by pupils. This was a deficiency which the previous OfSTED inspectors noted and specifically criticised. Finally, technology areas have pneumatics built in which has enhanced the width of the curriculum and new ICT facilities make CAD teaching possible now in Technology."*

***Voluntary Aided Primary***

*"The new facilities - especially those enabling more practical work in Science and Maths - have enhanced the amount of learning possible. In addition, the playing fields and all weather pitch (essential in one of the wettest parts of the UK) have provided new space and facilities for physical education."*

### *Increasing learning time*

Another way in which capital investment enhanced learning time was through the replacement or reorganisation of inadequate accommodation, which was inherently expensive in the use of teachers' or pupils' time, or inhibited desirable teaching methods. In this category of capital expenditure, heads indicated that time within the teaching day had previously been used for supervision or pupil movement, and the new accommodation allowed the time to be devoted to teaching.

***Voluntary Aided Primary***

*"The new building makes it easier for pupils to move around without losing time. Before, some had to come down two flights of stone steps to go to the outside toilets at the far end of the playground.*

*The new school on one storey means that pupils moving around the building in classes (start and end of sessions) do not need monitoring by as many teachers. The stone stairs before made monitoring of movement by all staff essential to avoid danger to pupils. Now only one member of staff is necessary and there is less inherent danger to avoid."*

The head was able to quantify this saving as a net gain of 7 minutes (10 previously and 3 now) per day per teacher. With 8 staff this equals about one hour per day; 180 hours per year or 10% of a teacher.

In addition, the design of the playgrounds and the hall (used for school dining) has meant that the school now employs 5 lunchtime assistants rather than the previous 8. The resources have been switched to direct educational expenditure.

In the particular case of a school which had formerly been on two sites over one mile apart, the headteacher was able to identify major time savings.

***Community Secondary***

The headteacher's estimate is that moving staff between sites cost 10% of lesson time (6 minutes per lesson) for 20% of lessons. There are roughly 750 lessons per week so the saving by moving onto one site has been 15 teaching hours a week or roughly 0.5 of a teacher.

Since any pupil is being taught for some 25 lessons a week of one hour duration, each pupil now has 30 more minutes teaching each week (a 2% increase). In fact the gain is greater since while a teacher was moving sites the pupils were either unattended and likely to misbehave or were being monitored by another teacher whose class was also not being taught. When the teacher arrived the pace of learning had been lost between lessons.

When, towards the end of the two site period, whole classes had to move site to meet the demands of the National Curriculum in Science, all the pupils lost 10 minutes per lesson during the changeover.

The previous OfSTED inspection, while the school was still on a split site, showed 70% of lessons as satisfactory or better. The OfSTED inspection afterwards showed this figure at 90%. In the head's opinion, the removal of the split site accounts for about half of the improvement.

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### *Extending the school day*

Capital investment also enhanced the amount of learning through improvements to accommodation that enabled the school day to be extended for pupils, by providing ready access to library, ICT and homework areas. For example, a number of schools had used the opportunity of new building or remodelling, to create areas of the school which could be used by pupils outside the normal school day.

> ***Community Secondary***
>
> Homework is now able to be done by pupils using the school library and associated ICT area from 8 am up to 6 pm each day.
>
> ***Community Secondary***
>
> *"The new ICT block is deliberately separate from the other blocks. This means we can make it more secure but more importantly it is accessible to pupils before and after normal school hours without the whole school being open."*

## Other factors affected by capital

### *Parental support*

It was noticeable that headteachers of primary schools and some Foundation schools considered that capital expenditure had a greater impact upon parental support, compared to headteachers in other secondary schools. This might be related to primary schools having more frequent, daily in most cases, contact with parents. In addition, in the recent history of Foundation schools, more emphasis has been placed on parental relationships compared to other secondary schools.

In most instances, the parental support was said to be influenced by their recognition of the quality of the new buildings and their enhanced wish for their children to experience such improved facilities. In a small number of cases the school had used the building work to create specific additional resources for parental use.

> ***Voluntary Aided Primary***
>
> *"Parents have always been supportive of the school but now have more access to us. They use the school hall for a coffee morning once a week, which was impossible in the old building. The school also provides a room for adult classes at some stages during the week (English for Bangladeshi mothers for example since 30% of the pupils have parents who were born in Bangladesh and have little English initially)".*

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### *Teacher leadership*

The capital expenditure which most influenced teacher leadership in primary schools was held to be the centralisation of the headteacher within a single building encompassing all the classrooms. This made the headteacher more accessible to and by staff. It enabled closer monitoring and support to be given to teachers.

***Community Primary***

Rationalisation of the building, ease of circulation, elimination of no-go areas, internal windows into classrooms all enabled the head to move freely and frequently around the school to observe and evaluate the quality of teaching and learning. Thus for staff this became an accepted part of her role leading to better quality management and supervision.

***Community Primary***

*"Classroom visiting and observation is now much easier and much less obtrusive. I can have a conversation with my teachers which is not about the latest roof leak, another mouse infestation or the smell of urine. It is actually possible to discuss education without the building intruding."*

***Community Secondary***

*"The creation of departmental suites - in science, technology and music, has enhanced the ability of the leaders of those teams to monitor and control staff and to use limited equipment to best advantage."*

### *Teacher recruitment*

Few schools had hard evidence that capital expenditure made teacher recruitment easier. However, the presence of modern facilities was held by some to be a strong factor in recruiting specialist staff in shortage subjects.

***Foundation Secondary***

*"We had a case of a Head of Technology who had a choice of two schools and chose us, on a lower salary point – because of our new Technology areas."*

***Foundation Secondary***

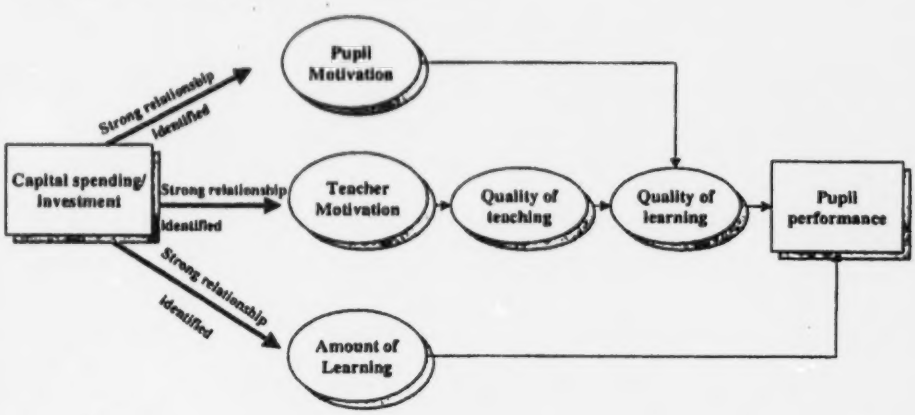
Recruitment in this area is a big issue because of the cost of housing and the reluctance of many teachers, for career progression reasons, to become involved in a selective system. The head believes strongly that first impressions, including areas such as reception and the staff room, are very important in persuading teachers, who effectively can choose where they take a job, that this school is the one they want to teach in.

## Conclusions

This section has presented an overview of some of the key findings from the qualitative research with headteachers. The research found that capital investment was judged to have a strong influence on three main factors, each of which had a major impact on pupil performance (see figure below):

- **Teacher motivation;** capital investment was found to be one of the two most important levers on teacher motivation through, for example, the boost to morale which teachers get from working in an appropriate and quality physical environment;
- **Pupil motivation:** e.g. through the visible sign that their education is valued by the teaching staff, and society in general;
- **Amount of learning:** e.g. by reducing the amount of time lost moving between different school buildings and classrooms.

**Overview of key findings from qualitative research**



# Section V
# Quantitative analysis

## Introduction

This section presents the main findings from a quantitative analysis of the links between capital investment and pupil performance in English schools. The analysis is based on a database, constructed as part of this study, which contains information on capital investment, pupil performance and a range of other variables (e.g. school type, socio-economic composition) in 1,916 English schools.[5]

The broad structure of this section is as follows:

- **Methodological approach:** this provides a description of the information contained in the database, and provides an overview of the type of statistical models which have been estimated;
- **Profile of capital investment:** this provides a simple descriptive analysis of the information in relation to capital spending, addressing questions such as 'how much money for capital spending did schools receive?', and 'what is the overall quality of the schools capital stock in England?';
- **Correlation analysis:** this investigates the direct correlation between capital and pupil performance, focusing on questions such as 'did the schools which received capital spending perform better over the subsequent period than schools in which there was no capital spending?', and 'did the schools which had a great deal of capital spending perform better than the schools which only had a little, or had none?'.
- **Multivariate analysis:** this presents the results of some multivariate models of the impact of schools capital on performance. Multivariate models estimate the impact of capital on performance, whilst simultaneously 'controlling for' the effects of a range of related factors. The key research question addressed in this section is: 'is there a statistically significant relationship between capital investment and pupil performance after having controlled for a range of related factors?';
- **Limitations of the analysis**: this sets out the main limitations of the analysis, mainly in term of issues relating to data quality;

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[5] It is important to note at the outset that the data were *not* designed for the purposes of conducting this research project. Rather, some key elements of the data (e.g. the information on capital spend), are essentially a by-product of administrative systems which have collected the information for other purposes. In the case of information on capital spend, this means that the information is not ideally suited to addressing the fundamental research question (for example, because smaller capital projects are excluded for certain types of school). Notwithstanding such difficulties, the approach adopted in this study has involved making the best use of the data which are available, whilst at the same time recognising that the overall conclusions of the study need to be mindful of the limitations of the data. This issue, along with some other important limitations to the analysis are discussed further in the sub-section entitled 'Limitations to the analysis'.

- **Conclusions:** this provides an overview of the main findings from the quantitative analysis.

## Methodological approach

### *Information contained on the database*

The database contained information in relation to four main groups of variables:

- **Capital investment:** two broad measures of capital investment were used in the analysis, namely:
  - ***Capital spending*:** i.e. the total amount of capital spending between 1993 and 1995. A summary of the main DfEE sources of information on capital spending is provided in Appendix B;
  - ***Adequacy of accommodation*:** i.e. the overall quality of the capital stock as assessed by OfSTED inspectors. This information is a ranking between 1 and 7, i.e. a school has a value of 1 if the adequacy of the accommodation is judged to be 'excellent', and a value of 7 if it is judged to be 'very poor'. This information was provided by OfSTED and is the only measure currently available of the adequacy of capital stock;
- **Pupil performance:** a range of measures of pupil performance were examined, as opposed to one particular measure. In particular, performance in both primary and secondary schools was examined and, within this, a number of specific measures of performance were used (see table below). This was done because the main aim of the study was to assess whether or not there are significant relationships between capital and performance generally, as opposed to performance at a particular stage in the educational cycle. By using a range of performance indicators, therefore, the study was able to take a balanced view about the overall relationship between capital and performance;

**Information on pupil performance used in the analysis**

| Level | Measure |
|---|---|
| **Primary Schools** | |
| Key Stage 1 | % of eligible pupils achieving Key Stage 1 level 2 or higher in Maths, Reading and Writing |
| Key Stage 2 | % of eligible pupils achieving Key Stage 2 level 4 or higher in Maths, English and Science |
| **Secondary Schools** | |
| Key Stage 3 | % of eligible pupils achieving Key Stage 3 level 5 or higher in Maths, English and Science |
| GCSE | % of 15 year olds achieving at least 5 A*-C grades at GCSE |
| A Level | Average points score of candidates entered for 2+ GCE A/AS levels |

*Notes: The database contains information in relation to these factors for each year between 1995 and 1999. Most of the quantitative analysis has been based on changes in performance between 1995 and 1999 in particular. However, an assessment was also conducted of the effects of capital investment on changes in performance between, for example, 1995 and 1997, 1997 and 1999 etc. Note also that some primary schools have both Key Stage 1 and Key Stage 2 pupils, others have only Key Stage 1 and others only have Key Stage 2. Our approach to this in the statistical work has been to maximise the amount of information used, i.e. when examining the factors which influence Key Stage 1 performance we have used information on all those schools on our database for which we have Key Stage 1 performance information, and likewise for Key Stage 2.*

- **Background information:** a wide range of background information relating to the schools on the database was included in the analysis. This included a number of key characteristics of schools including level of qualifications attained, free school meals, school size, class size, school type, school gender, school selection policy;

- **Information on OfSTED variables:** an important part of the analysis involved examining the inter-relationships which exist between capital investment and performance on the one hand, and a range of OfSTED variables on the other hand. The OfSTED variables represent a range of indicators of more qualitative features of the school, and are based on OfSTED inspectors' reports. All of the variables are ranked 1 to 7; generally speaking, a value of 1 represents 'excellent' and 7 represents 'very poor'. The main OfSTED variables which have been examined in the analysis have included: teacher quality; adequacy of general school resources; leadership; school ethos; parental involvement; attitudes; behaviour; relationships.

## *Types of statistical models estimated*

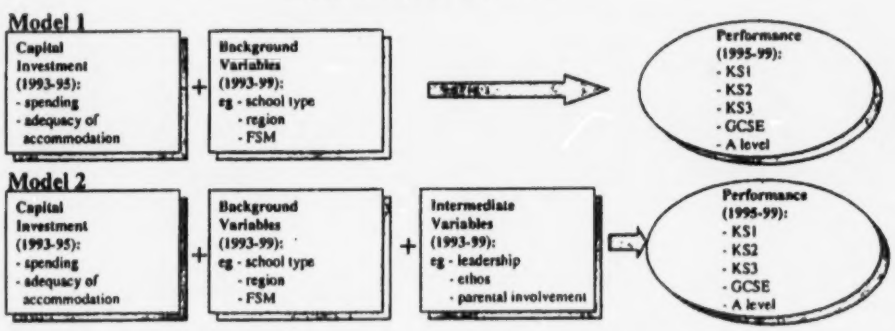
The broad structure of the statistical models which we have estimated is illustrated in the figure on the following page. It can be described in terms of two broad 'models' as follows:

- **Model 1:** this illustrates the situation in which the effects of capital investment on pupil performance are examined after having 'controlled for' a range of 'background variables' (e.g. school type, region etc);

- **Model 2:** this is the same as Model 1 except that, in addition to the full range of background variables, it also controls for the effects of a range of OfSTED variables (e.g. leadership, ethos etc).

**Broad structure of statistical models**

**Impact of capital on performance**

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## Profile of capital investment

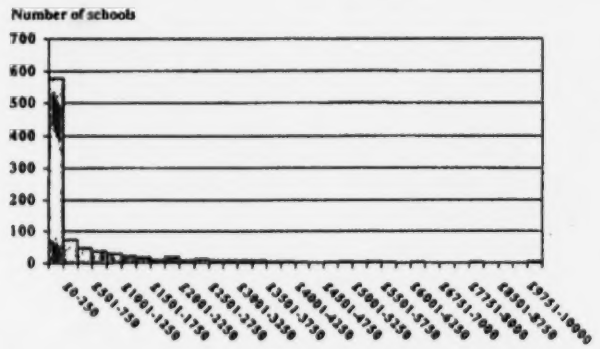
### *Average capital spending*

The average *total* capital spending amongst the schools on the database for 1993-95 was £377,071 for primary schools and £604,340 for secondary schools[6]. The corresponding average level of capital spending *per head* was around £900-£1,100 *per pupil* for primary schools, and £500 - £700 *per pupil* for secondary schools (see figure below).

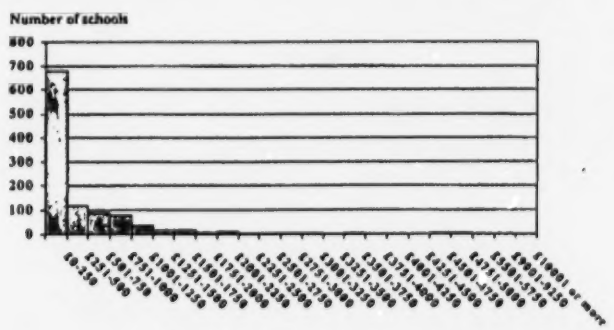
Average spending per head was higher in primary schools compared to secondary schools, whereas total spending per school was higher in secondary schools compared to primary schools. This reflects the fact that secondary schools are generally larger (in terms of the number of pupils) than primary schools.

The distribution of capital spend is 'skewed to the left'. This means that the majority of schools receive relatively small amounts of capital spend (see figures below).

**Profile of capital spending per head (primary schools, 1993-95)**




**Profile of capital spending per head (secondary schools, 1993-95)**



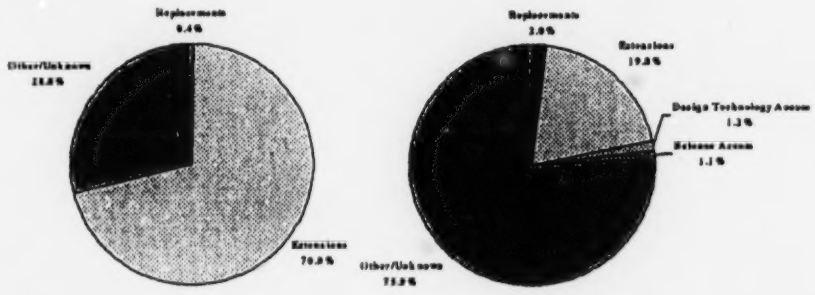

[6] Capital cost information was based on the costs of tenders, expressed in terms of 1998 prices. An allowance was made for professional fees. No adjustment was made in respect of the variation which exists in pricing levels between different regions of the UK. New schools were excluded. The information relates to capital expenditure during the financial years 1992-93, 1993-94 and 1994-95.

## *Categories of capital spending*

Generally speaking, it was difficult to classify total spending according to the different types of spending (extensions, replacements etc). In particular, around three quarters of spending in secondary schools, and around one quarter of spending in primary schools, was classified under the 'Other/Unknown' category. In relation to spending which could be assigned a category, the majority of capital spending in both primary and secondary schools was on 'extensions' .

**Profile of expenditure types, 1993-95**

**Primary schools** **Secondary schools**



## *Adequacy of capital stock*

Primary schools were given a more satisfactory rating in relation to the quality of their accommodation than secondary schools (see table overleaf). Amongst secondary schools, VA schools seemed to have a much less favourable ranking of their capital stock compared to GM and County secondary schools. Amongst primary schools, GM schools seemed to have the most favourable ranking compared to both County and VA schools. Generally speaking, capex schools[7] had a more satisfactory accommodation ranking compared to control schools. This is particularly the case amongst primary schools.

[7] Note: 'Capex' refers to those schools in the sample in which there had been some capital expenditure between 1993 and 1995, and 'control' refers to those schools in which there had been none.



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**Adequacy of accommodation gradings**

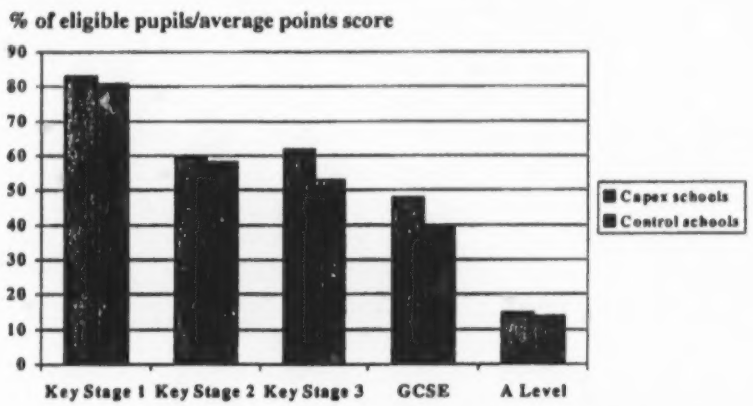
| | Grade | % of schools | |
|---|---|---|---|
| | | Primary | Secondary |
| All schools | Very poor | 0.2 | 0.2 |
| | Poor | 1.9 | 3.9 |
| | Unsatisfactory | 9.8 | 19.0 |
| | Satisfactory | 40.6 | 45.1 |
| | Good | 33.8 | 22.2 |
| | Very good | 12.7 | 9.4 |
| | Excellent | 1.0 | 0.3 |
| | | 100.0 | 100.0 |
| VA | Very poor | 0.3 | 0 |
| | Poor | 2.9 | 5.8 |
| | Unsatisfactory | 11.4 | 31.7 |
| | Satisfactory | 46.5 | 43.2 |
| | Good | 30.7 | 9.6 |
| | Very good | 7.9 | 7.7 |
| | Excellent | 0.3 | 0 |
| | | 100.0 | 100.0 |
| GM | Very poor | 0 | 0 |
| | Poor | 0 | 3.3 |
| | Unsatisfactory | 6.8 | 15.6 |
| | Satisfactory | 27.1 | 48.3 |
| | Good | 47.4 | 23.4 |
| | Very good | 15.8 | 8.6 |
| | Excellent | 3.0 | 0.7 |
| | | 100.0 | 100.0 |
| County | Very poor | 0.3 | 0.3 |
| | Poor | 1.6 | 3.8 |
| | Unsatisfactory | 9.3 | 17.5 |
| | Satisfactory | 40.0 | 42.0 |
| | Good | 31.8 | 25.5 |
| | Very good | 16.2 | 10.8 |
| | Excellent | 0.8 | 0 |
| | | 100.0 | 100.0 |
| Capex | Very poor | 0.2 | 0.3 |
| | Poor | 1.0 | 3.6 |
| | Unsatisfactory | 10.1 | 17.0 |
| | Satisfactory | 32.0 | 46.1 |
| | Good | 38.4 | 22.4 |
| | Very good | 16.3 | 10.2 |
| | Excellent | 2.0 | 0.5 |
| | | 100.0 | 100.0 |
| Control | Very poor | 0.2 | 0 |
| | Poor | 2.8 | 4.5 |
| | Unsatisfactory | 9.4 | 21.8 |
| | Satisfactory | 48.6 | 43.6 |
| | Good | 29.5 | 21.8 |
| | Very good | 9.4 | 8.3 |
| | Excellent | 0 | 0 |
| | | 100.0 | 100.0 |

***Note: 'Capex' refers to those schools in the sample in which there had been some capital expenditure between 1993 and 1995, and 'control' refers to those schools in which there had been none.***

### *Capital investment and performance levels*

There is some evidence to suggest that the schools which had capital expenditure over the period 1993-5 tended to have higher average performance levels. For example, average performance levels in 1995 for each of the five measures were higher for capex schools than controlled schools (see figure below).

**Performance *Levels* for Capex and Control Schools, 1995**




Key Stage 1 - performance defined as % of eligible pupils achieving Key Stage 1 Level 2 in Maths, Reading and Writing (1995)
Key Stage 2 - performance defined as % of eligible pupils achieving Key Stage 2 Level 4 in Maths, English and Science (1995)
Key Stage 3 - performance defined as % of eligible pupils achieving Key Stage 3 Level 5 in Maths, English and Science (1995)
GCSE - performance defined as % of 15 year olds achieving at least 5 A*-C grades at GCSE (1995)
A Level - performance defined as average point score of candidates entered for 2+ GCE A/AS Levels (1995)

The overall picture is more mixed with respect to the adequacy of accommodation and performance levels. In particular, some measures of performance levels are higher for schools with a high quality capital stock (e.g. A level and Key Stage 1), whereas others are lower (e.g. Key Stages 2 and 3 and GCSE – see figure below).

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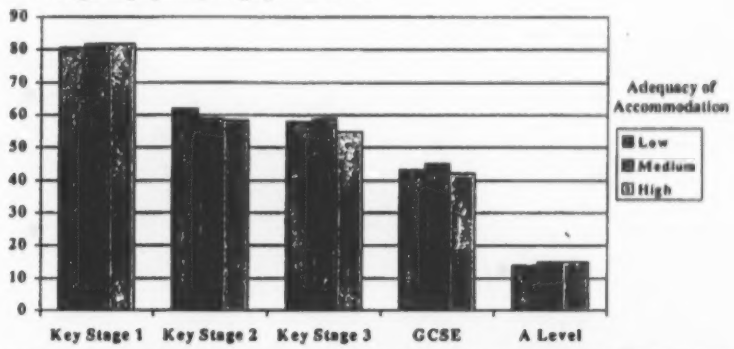
**Performance *Levels* by Adequacy of Accommodation**



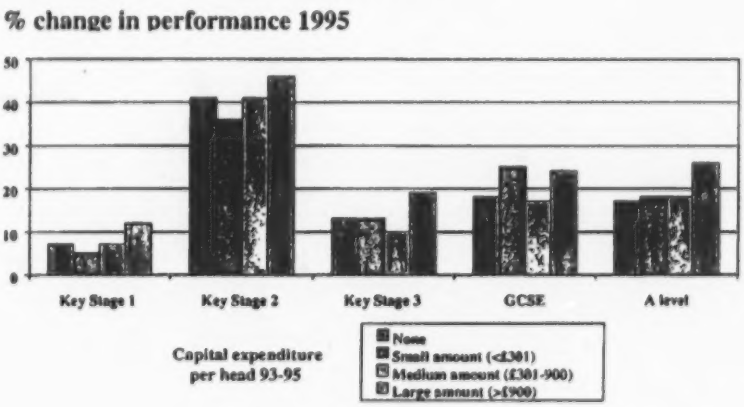

Key Stage 1 - performance defined as % of eligible pupils achieving Key Stage 1 Level 2 in Maths, Reading and Writing (1995)
Key Stage 2 - performance defined as % of eligible pupils achieving Key Stage 2 Level 4 in Maths, English and Science (1995)
Key Stage 3 - performance defined as % of eligible pupils achieving Key Stage 3 Level 5 in Maths, English and Science (1995)
GCSE - performance defined as % of 15 year olds achieving at least 5 A*-C grades at GCSE (1995)
A Level - performance defined as average point score of candidates entered for 2+ GCE A/AS Levels (1995)

## Correlation analysis

### *Capital expenditure and average changes in performance*

Average percentage changes in performance are sometimes lower in schools in which there have been small and medium amounts of capital spending, compared to schools in which there has been no capital expenditure. More encouragingly, schools in which there have been large amounts of capital spending generally improve their performance by more than those schools in which there was no capital spending. For example, secondary schools in which there was no capital spending improved their A Level performance (as measured by A Level points scores) by 17%; this compares to an average increase of 26% in those schools which spent relatively large amounts on capital. Similarly, primary schools in which there was no capital spending improved their Key Stage 1 performance (as measured in terms of Level 2 achievement in Maths, Reading and Writing) by around 7%; this compares to an average increase of around 12% in those schools which spent a relatively large amount on capital.

**Correlation analysis – average changes in performance**

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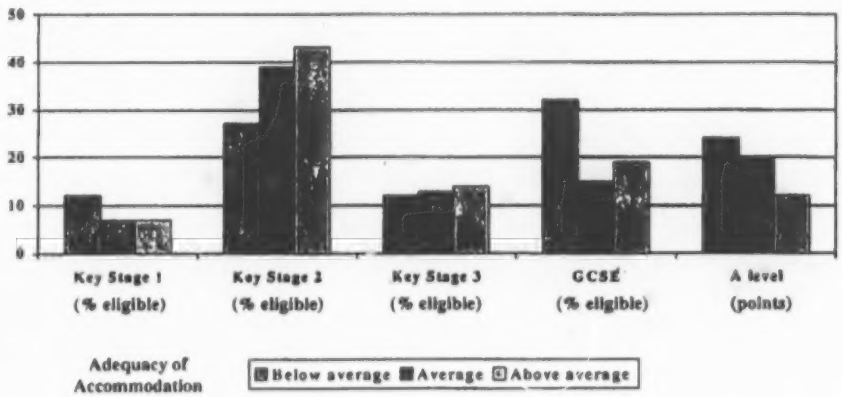
### *Adequacy of accommodation and average changes in performance*

The correlation between the adequacy of accommodation, as assessed by OfSTED inspectors, and percentage changes in pupil performance between 1995 and 1999 is shown in the figure below. Again, the figures suggest a 'mixed message' in relation to the capital – performance relationship. For example, at Key Stages 2 and 3, schools with above average accommodation perform better than schools in which the accommodation was of average or below average quality. However, at the other levels of education (Key Stage 1, GCSE and A Level), schools with good accommodation improve their performance by less than schools with poor accommodation.

**Correlation analysis – average changes in performance**

**% change in performance 1995 - 1999**




### *Analysis of correlation patterns*

The table on the next page provides an overview of some of the 'correlation coefficients' which have been calculated between the following two variables:

- average capital spending per pupil (1993-95);
- subsequent percentage changes in performance (1995-99).

In addition, a series of partial correlation co-efficients are presented in Appendix C. These are based on different sub-groups of the data, eg VA, GM and County schools, schools with different proportions of pupils claiming free school meals, and schools of different size. Amongst the key findings to emerge from the analysis of correlation coefficients are:

- **nature of the relationship:** the patterns of correlation between capital spend and pupil performance are mixed, i.e. there are some positive correlation coefficients and some negative ones;
- **strength of the relationship:** the figures suggest that the strength of the relationship is generally quite small, i.e. the absolute values of the coefficients are quite small, the largest one being 0.238 for County schools in relation to Key Stage 3 performance (this correlation is illustrated in the figure overleaf);

- **statistical significance of relationship:** the majority of the estimated coefficients are not significant from a statistical point of view. There are, however, some exceptions. The most significant positive relationships seem to be in relation to capital spending and performance at Key Stages 1 and 3.

**Correlation coefficients between capital investment and performance change 1995-99**

| | All | GM | VA | County |
|---|---|---|---|---|
| **Capital spending versus performance** | | | | |
| Key Stage 1 | +.091** | -.065 | +.085 | +.114* |
| Key Stage 2 | +.005 | -.087 | -.017 | +.013 |
| Key Stage 3 | +.137** | -.082 | -.007 | +.238** |
| GCSE | -.003 | +.045 | +.166* | +.004 |
| A Level | +.047 | +.019 | +.009 | +.077 |
| **Adequacy of accommodation versus performance** | | | | |
| Key Stage 1 | -.033 | +.099 | -.161** | +.054 |
| Key Stage 2 | +.092 | +.099 | +.006 | +.136 |
| Key Stage 3 | +.042 | -.041 | +.072 | +.119 |
| GCSE | -.033 | -.079 | +.010 | +.072 |
| A Level | -.074 | -.123 | -.041 | -.073 |

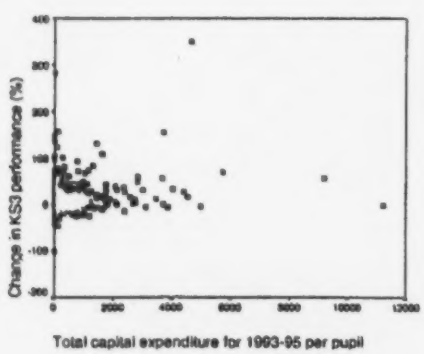
*Notes:*

*Nature of relationship – a positive sign on the co-efficient means that there is a positive relationship between the two variables, ie increases in capital spending are associated with improvements in performance. A negative sign indicates that there is a negative relationship, ie increases in spending are associated with reductions in performance.*

*Strength of relationship – the strength of the relationship between the two variables in indicated by the size of the co-efficient, which can range from –1 through to 0 and through to +1. The closer the co-efficient is to a value of plus or minus 1, the stronger is the overall relationship.*

*Statistical significance of relationship – measures can be calculated of how significant the estimated relationship is from a statistical point of view. The measures adopted in the present analysis are based on a 'two tailed' test of significance at the 95% and 99% levels. If an estimated co-efficient is statistically significant at the 99% level, this means that we can be 99% sure that there is some relationship between the variables, as opposed to no relationship. * means that the relationship is significant at a 95% level (two tailed) and ** means it is significant at a 99% level.*

**Correlation between capital spend and change in KS3 performance**



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## Multivariate analysis

### *Multivariate estimates of the impact of capital investment on performance*

The results for our main Ordinary Least Squares (OLS) regression models are presented in Appendix C, and a summary is provided in the table below. Amongst the key findings to emerge in relation to the impact of capital on pupil performance are the following:

- generally speaking, the results of the multivariate analyses are slightly more positive about the relationship between capital spend and performance than the results of the correlation analysis presented in the previous sub-section;
- in particular, the models suggest that capital spending has a positive and statistically significant impact on performance changes at Key Stage 1 and Key Stage 3.

**Summary of regression analysis**

| | | KS 1 | KS 2 | KS 3 | GCSE | A Level |
|---|---|---|---|---|---|---|
| Model 1 | Spending | +** | - | +** | + | + |
| | Adequacy | - | + | + | + | - |
| Model 2 | Spending | +** | - | +** | + | + |
| | Adequacy | - | + | - | - | - |

*Notes: This summary is based on the results of regression models 1 and 2 in Appendix C. By way of summary, Model 1 estimates the impact of capital on performance after having controlled for a range of background variables. Model 2 does the same, but also controls for a range of OfSTED variables. A (+) means that the estimated coefficient is positive, and a (-) means that it is negative. A (**) means that the estimated coefficient is significant from a statistical point of view.*

### *Overview of nature and strength of relationship*

It is important to note that the absolute size of the effect of capital spend on pupil performance is relatively weak, i.e. capital-related changes in performance are small relative to changes which can be related to other factors such as the socio-economic composition of the school. This is best illustrated with respect to performance at Key Stage 1 and Key Stage 3 which, as outlined above, the models suggest are rather more sensitive to capital spend than other measures of performance. The analysis suggests that an increase of the equivalent of £100 in average spending per head in primary schools, would result in a corresponding increase in performance of around 0.04 percentage points, from 8% to 8.04%; this represents a *proportionate* increase of 0.5%. For Key Stage 3, a corresponding capital injection would improve performance by around 0.4 percentage points, from 13% to 13.4% (see table overleaf for further details); this represents a *proportionate* increase of 3%.

**Overview of nature and strength of capital – performance relationship**

| | |
|---|---|
| **Key Stage 1** | |
| **Background information** | |
| Average capital spending per head 1993-95 (primary schools) | £1,767 |
| Proportionate increase in Key Stage 1 performance 1995-99 | 8% |
| Estimated coefficient on capital spending per head variable (based on OLS regression results) | 0.0004 |
| ***Therefore*** | |
| An increase of the equivalent of £100 in average spending per head, would result in a corresponding increase in performance of around .... | 0.04pp |
| ***For example*** | |
| The school would improve its increase in performance from .... | 8% to 8.04% |
| Representing a *proportionate* increase of ... | 0.5% |
| **Key Stage 3** | |
| **Background information** | |
| Average capital spending per head 1993-95 (secondary schools) | £718 |
| Proportionate increase in Key Stage 3 performance 1995-99 | 13% |
| Estimated coefficient on capital spending per head variable (based on OLS regression results) | 0.004 |
| ***Therefore*** | |
| An increase of the equivalent of £100 in average spending per head, would result in a corresponding increase in performance of around .... | 0.4pp |
| ***For example*** | |
| The school would improve its increase in performance from .... | 13% to 13.4% |
| Representing a *proportionate* increase of ... | 3% |

## *Illustrative example of the strength of the capital effect*

The figures presented above can be made more intuitive by considering the example of an individual secondary school, say St Johns Secondary School, which had around 1,500 pupils on the roll, and which received a per capita injection of capital between 1993 and 1995 of around £700 (i.e. the secondary school average). Nearly three fifths of pupils in St Johns had achieved Key Stage 3 Level 5 or above in Maths, English and Science in 1995, corresponding to nearly 233 pupils out of the 400 in the relevant year group. By 1999, nearly 264 pupils had achieved this level at Key Stage 3. The results of the models suggest that the overall impact of an additional £100 per capita capital spending on this improvement is rather modest, corresponding to one extra pupil achieving this level at Key Stage 3 as a result of the injection of capital. Of course, this relates to the improvement in performance over a four year period. If the impact of the capital investment is evaluated over a longer period, a larger number of pupils would be affected. For example, if the impact is evaluated over a twelve year period, the models would estimate that *three* extra pupils would achieve the relevant level at Key Stage 3.

### *Results of the sensitivity analysis*

It is important to restate that the data were *not* designed for the purposes of conducting this research project. Rather, some key elements of the data (e.g. the information on capital spend), are essentially a by-product of administrative systems which have collected the information for other purposes. In the case of information on capital spend, this means that the information is not ideally suited to addressing the fundamental research question (for example, because smaller capital projects are excluded for certain types of school). Notwithstanding such difficulties, the approach adopted in this study has involved making the best use of the data which are available whilst at the same time recognising that the overall conclusions of the study need to be mindful of the limitations of the data. This issue, along with some other important limitations to the analysis are discussed further in the sub-section entitled 'Limitations to the analysis'.

A summary of the key findings of the sensitivity analysis, in terms of the estimated coefficients for the capital – performance relationship, is presented in Appendix C. From the point of view of the present study, it is most important to consider the overall patterns which these results display, as opposed to the individual coefficients in relation to specific models. By way of summary, therefore, two of the main points to emerge from the sensitivity analysis are as follows:

- The sensitivity analysis generally confirms the finding that the estimated size of the effect of capital is relatively small and is often statistically insignificant;

- The sensitivity analysis generally confirms the finding that performance at Key Stages 1 and 3 tend to be rather more responsive to capital investment than other levels / measures of performance;

### *The impact of capital on other variables*

A strong relationship was estimated between capital investment and some of the OfSTED variables which reflect more qualitative features of the school environment. In particular, the analysis found that :

- Good teaching takes place in schools with a good physical environment, i.e. schools in which the quality of the capital stock is judged to be favourable;

- Good leadership can also be found in schools with a high quality capital stock;

- The general attitudes, behaviour and relationships amongst pupils and staff are more conducive to learning in those schools which have had significant capital investments.

Whilst data limitations prevent a strong 'cause and effect' interpretation of these findings, they are nevertheless consistent with the main findings to emerge from our qualitative research with headteachers.

### *Other influences on performance*

The quantitative analysis also provides some evidence in relation to the other factors which are likely to have an important influence on pupil performance:

- **Prior pupil attainment:** schools which are starting out from a relatively high base (i.e. whose performance levels at the beginning of the period are relatively high), tend to improve their performance by less than schools which are starting out from a lower base. This is a robust effect which is found consistently in all the models, irrespective of which measure of performance is used;[8]

- **Free school meals:** in analysis of this nature, the proportion of pupils eligible to claim free school meals is generally used as a proxy for the socio-economic composition of the pupils in the school. Generally speaking, the higher the proportion of pupils eligible to claim free school meals, the less favourable is the overall socio-economic composition of the school's pupils. In terms of the impact of the free school meals indicator, the main finding to emerge from the analysis is that schools in which a large proportion of pupils are eligible to claim free school meals generally improve their performance by less than those schools in which only a small proportion of pupils are eligible;

- **School and class size:** in terms of the impact of the school size and class size variables, the main finding is that, after controlling for the other related factors, smaller schools tend to improve their performance by more than larger schools. It is interesting that the coefficient on the school size variable is only statistically significant in relation to Key Stage 1 performance. The effects of class size are not systematic across all measures of attainment. However, there is some evidence that performance improvements are lower at Key Stage 2 in larger classes;

- **Gender composition:** in terms of the impact of the gender composition of the school (i.e. whether the school is single sex or mixed), the Models provide some evidence to support the view that pupils in single sex schools tend to improve their performance by more than pupils in mixed schools;

- **School management type and admissions policy:** in terms of the impact of school management type variables, the key finding to emerge from the analysis is that VA schools and, to a lesser extent, GM schools have tended to improve their performance by more than County schools, all other things being equal. Selective schools have improved their performance by more than non-selective schools.

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[8] It is worth noting that this finding relates to the *independent* effect of the initial level of attainment on subsequent pupil performance, i.e. the results show that *after having accounted for* the potentially-related effects of all other factors, schools with a higher level of attainment generally improve their performance by less. In this light it is worth noting that, as outlined earlier in this section, there is some evidence to suggest that schools which received capital expenditure tended to have higher average levels of initial attainment. This means that if the capital – performance relationship is examined *without* controlling for the effects of prior pupil attainment, the results are likely to *underestimate* the impact of capital on performance. This confirms the importance of including prior pupil attainment information in the econometric models (which enabled the impact of capital on performance to be assessed, after having controlled for the effects of prior pupil attainment).



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## Limitations of the analysis

The key findings in relation to the capital – performance relationship have been, perhaps, less positive than might have been expected, particularly in light of the rather more positive findings from our own, and other, qualitative research which has examined the nature and strength of the relationship. In this regard, however, it is important to reiterate that the findings from this research are very much consistent with the findings from other quantitative studies conducted mainly in the US. Nevertheless, it is possible, at least in principle, that the relatively modest capital – performance relationship can be attributed to some extent to the limitations of the analysis, as opposed to the lack of a strong underlying relationship. The main limitations of the analysis in relation to the estimates of the capital – performance relationship are as follows:

- **Inconsistencies in data collection methods for capital information:** there are a number of potential inaccuracies with respect to the information on capital spend. This is because the information is drawn from a range of sources within the Department, and is collected on a different basis in relation to different school types (VA, GM and County). It is possible in principle that the relatively modest relationship between capital and performance reflects the poor quality of some of the capital data, as opposed to the lack of an underlying relationship;

- **Lack of accurate information on the type of capital spending:** the analysis has shown that the data in relation to the type of capital projects is very limited. This has meant that the data used for the quantitative analysis are aggregate data which include projects relating to basic need (sufficiency), like for like replacement (condition) and improvement works (suitability). With the first two of these categories, it might be expected that the main impact of capital would be in terms of *preventing a deterioration* in pupil performance. It is only with the last of the three categories that, *a priori*, one would expect capital spending to have a significant, direct and easily measurable impact on *improving* performance. The relatively modest relationship between capital and performance, therefore, might reflect the fact that projects in relation to sufficiency and condition have been included in the analysis, and that the links between these and pupil performance are more difficult to identify empirically. It is important in this context to note that in the early 1990s only around 30% of all capital spending in VA schools related to improvement works, with the remainder relating to basic need (36%) and like for like replacement (34%);

- **Potential 'contamination' of the control group**: there is a possibility that capital expenditure in control group schools just prior to the study period might have had a delayed impact on school attainment results in the period 1995-99, thereby "contaminating" the control group and reducing the differences in attainment noted between the capex and control schools. In addition, it is possible that some of the control group schools received capital expenditure during the study period, and this would further reduce the differences;

- **Timing of the effects:** the time period covered in the analysis has been largely determined by data availability. In particular, the study was constrained to examine the 'short-to-medium term' impact of capital on performance. It may well be that the main impact of capital on performance only becomes evident over the longer term; it has not been possible to assess this in the analysis.

## Conclusions

The main aim of the quantitative analysis was to assess statistically the nature and strength of the relationship between capital spend and pupil performance, using data for English schools. Amongst the key findings to have emerged from the research are the following:

- The analysis provides *some* evidence of a positive and statistically significant relationship between capital investment and pupil performance, i.e. there is some evidence to suggest that investing in schools capital can help to improve overall pupil performance;

- However, the estimated relationship between capital and performance is not universally positive, nor is it universally statistically significant. Nevertheless, on balance, the research suggests that where there are statistically significant effects of capital on performance, these are positive and, therefore, consistent with prior expectations. These findings are consistent with existing research in this field;

- The results also suggest that some performance measures are more sensitive to capital investment than others. In particular, the most important effects seem to be in relation to the earlier stages in the educational process, especially Key Stage 1 and Key Stage 3. Improvements in pupil performance at other levels seem to be relatively unresponsive to capital investment;

- The absolute size of the effect of capital spend on pupil performance is relatively weak, i.e. capital-related changes in performance are small when compared with changes which can be related to other factors such as the socio-economic composition of the school;

- Good teaching takes place in schools with a good physical environment, i.e. schools in which the quality of the capital stock is judged to be favourable;

- Good school leadership can also be found in schools with a high quality capital stock;

- The general attitudes, behaviour and relationships amongst pupils and staff are more conducive to learning in those schools which have had significant capital investments.

# Section VI
# Conclusion

This study represents the first major attempt in the UK to examine empirically the relationship between capital investment in schools and pupil performance.

The review of existing literature showed that the majority of existing quantitative studies have found positive relationships between capital spending and performance. It also showed, however, that these relationships were not always significant from a statistical point of view, and that some studies have found negative relationships to exist. Similarly, the quantitative work conducted as part of the current study, has provided additional evidence of a positive and statistically significant relationship between capital investment and pupil performance. However, in common with the findings of other studies, the estimated relationship is relatively weak. Furthermore, the relationship was not positive in all cases, nor was it always statistically significant.

The relationship estimated by the qualitative studies examined in our literature review, however, is a stronger one. This is consistent with the more positive findings from the interviews that we undertook with headteachers and others in the qualitative work stream. The general view emerging from these interviews was that capital expenditure in schools is strongly linked to pupil attainment. Perhaps the most intuitive evidence of a positive relationship is to be found in the architecture literature in those studies relating to specific design features of schools and the overall quality of school buildings. It was these very design features that the heads interviewed in our qualitative work emphasised as having strong links with teacher and pupil motivation, which were themselves identified as being strongly linked to pupil performance.

It appears, therefore, that the findings of qualitative studies tend to be rather more positive about the capital – performance relationship compared to quantitative studies. This is likely to be related to the fact that quantitative studies are based on aggregate measures of capital expenditure which include certain forms of spending which we would not expect to be linked directly to pupil performance.

It is easier to be clear about the types of conclusions which should not be drawn from this study. In particular, a conclusion should not be drawn from this study that expenditure should not be made in schools upon programmes related to objectives such as the provision of basic places, the promotion of health and safety or the access of pupils with disabilities.

It is clear on the basis of the above discussion that there is considerable scope for conducting further research on the capital – performance relationship. In this regard two main suggestions are worth making:

- **A local area study:** the analysis presented in the report has been based on a sample of schools throughout England. Consideration should be given to conducting a more localised study which examines, for example, all schools within a certain Local Authority area. Doing this would have a number of advantages: firstly, a locally-based study would enable the research to control more effectively for the range of other factors which potentially impinge on the capital – performance relationship (sometimes referred to in

research as background 'noise'). Secondly, it is our understanding that some Local Education Authorities have, going back over several years, detailed information in relation to the amount and, particularly, the type of capital spend. Potentially, this information could help to overcome some of the main data limitations which were encountered as part of the present study;

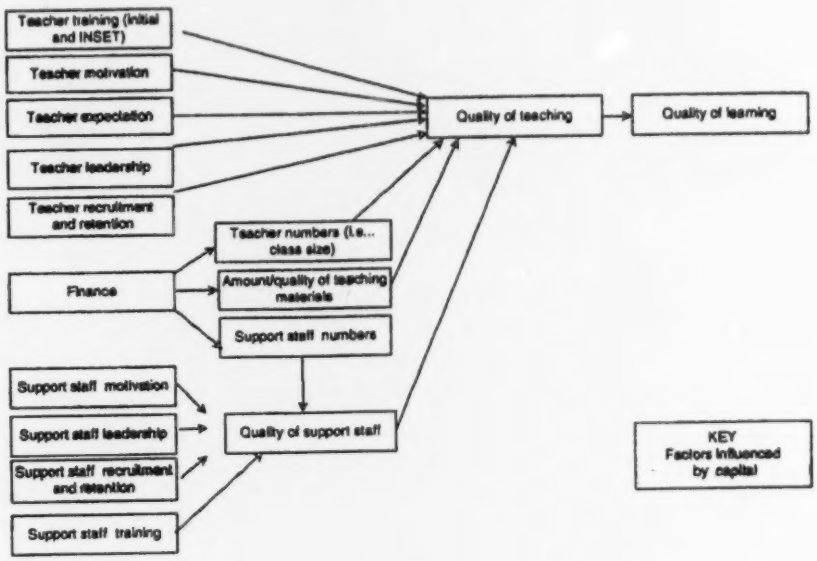
- **A 'schools capital panel':** in the longer term it is important that the Department collects the kind of information in relation to capital spend which will enable it to address in a rigorous manner the fundamental research question which has been the subject of the present analysis. This will enable the Department, inter alia, to assess the relative effectiveness of the different capital investments. To this end, consideration should be given to constructing a 'schools capital panel'. This would be a sample of schools throughout England on which detailed information in relation to the nature and extent of capital spend is gathered on an annual basis. The panel element of the sample would be critical, and a minimum period of around seven years would need to run before any relevant analysis of the medium-term capital – performance relationship could be conducted. If carefully designed, such a panel survey of English schools could overcome all of the main limitations to the existing data, outlined above. For example, if the information was collected by means of a telephone or postal questionnaire return, the design of such a questionnaire could ensure that appropriate and detailed information on the type of capital spend was included, and that there was no 'contamination' in the relevant control group.

# Appendix A Additional information on qualitative research design

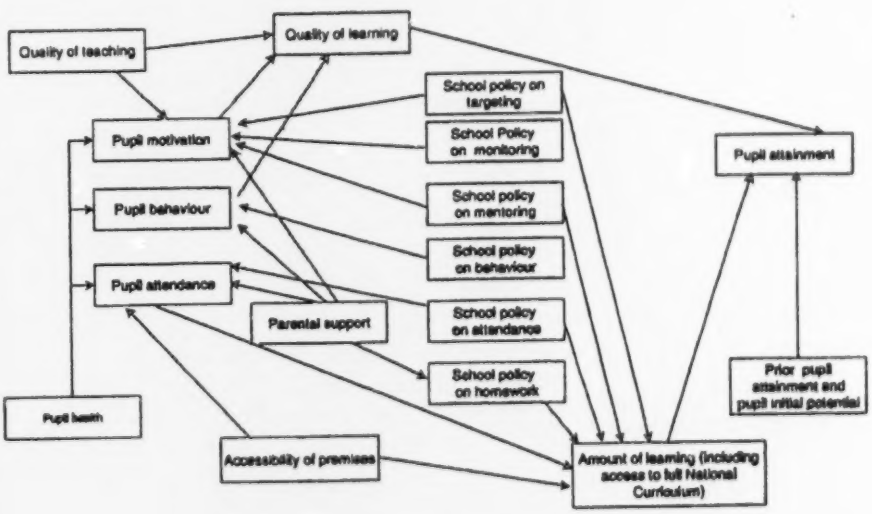
- Conceptual model of the factors influencing pupil attainment
- Topic list for interviews with headteachers

## Conceptual model of the factors influencing pupil attainment

**Part 1**




**Part 2**

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## Topic list for interviews with headteachers

### *Factors influencing attainment*

1 What factors do you believe have most influenced the educational achievements of pupils at your school? What are the mechanisms by which these factors have influenced attainment?

2 What capital expenditure has taken place in your school in recent years? Is this expenditure best categorised as addressing the issues of "sufficiency", "condition" or "suitability" and/or what is the appropriate split between these categories if the expenditure has addressed more than one category?

3 [If not mentioned in response to Question 1] How important, if at all, has the capital expenditure been in influencing your pupils' educational achievements?

4 How would you quantify the contribution made by each of the following factors to the educational achievements of pupils at your school? Please rate each factor out of 100% according to its contribution (if any) to the total attainment effect. [Interviewer – add in any factors already mentioned by interviewee that are not in the list below.]

- **Quality of learning** comprising quality of teaching, pupil motivation, pupil behaviour;
- **Amount of learning**, comprising pupil attendance, school policy on attendance, school policy on home work, school policy on mentoring, school policy on targeting;
- **Prior pupil attainment.**

### *Factors influenced by capital spend*

NB – for each factor below, ask the head for his/her view on the strength of the influence (on a scale of 1-5 with one representing very low influence and 5 very high influence) that capital spend exerts on the factor.

**Finance [strength = ]**

5 Has capital expenditure brought about - or was it planned to bring about - significant reductions in the costs of running your school? If so, what category of capital expenditure has had the greatest effect?

6 Where appropriate, what scale of resources has been released and how have the released resources been used by your school (eg for the purchase of further teachers or ancillary staff or more/better teaching materials including ICT equipment)? Has this impacted on pupil attainment? If so, how?

**Teacher motivation [strength = ]**

7 What effect (if any) have the building works in your school had upon teacher motivation? What category of building works has had the greatest effect?

8 Was there an adverse impact on morale related to the management/scheduling of the actual building works? Did morale reduce as teachers become used to the new/improved facilities and, if so, did it return to its former level or remain at a new higher plateau?

9 Were any effects on morale related to the perceived condition of neighbouring schools? Have changes in teacher morale fed through into pupil attainment and, if so, how?

**Teacher leadership [strength = ]**

10 What characteristics of building work, if any, have most assisted you in improving your leadership of your school? Have improvements in leadership fed through into pupil attainment and, if so, how?

**Teacher recruitment and retention [strength = ]**

11 What impact, if any, has building work had upon your school's ability to recruit and retain staff? What category of building works has had the greatest effect? Have improvements in teacher recruitment/retention fed through into pupil attainment and, if so, how?

**Ancillary staff [strength = ]**

12 What effect, if any, have building works had on the morale, recruitment/retention and leadership of your ancillary staff? What category of building works has had the greatest effect?

13 Can a distinction be drawn between different types of ancillary staff (say ancillary staff working in classrooms with pupils, administrative staff, building related staff and technical support staff)? Have ancillary staff improvements fed through into pupil attainment and, if so, how?

**Pupil health [strength = ]**

14 Do you believe that child health issues are still a relevant factor when considering the case for capital expenditure?

15 Is there any evidence from your school that particular building work has a direct impact on children's health and therefore upon their school attendance? Have pupil health improvements fed through into pupil attainment and, if so, how?

**Pupil attendance [strength = ]**

16 Have building improvements impacted directly upon attendance at your school? If so, what category of building works has had the greatest effect? Have improvements in pupil attendance fed through into pupil attainment and, if so, how?

**Pupil motivation [strength = ]**

17 Has pupil motivation been affected by building works at your school? If so, what category of building works has had the greatest effect? Was there an adverse impact on morale related to the management/scheduling of the actual building works?

18 Did pupil morale reduce as they became used to the new/improved facilities and, if so, did it return to its former level or remain at a new higher plateau? Were the effects on morale (if any) related to the perceived condition of neighbouring or, in the case of secondary students, previous schools?

19 Have pupil motivation improvements fed through into pupil attainment and, if so, how?

**Pupil behaviour [strength = ]**

20 Has the behaviour of pupils in your school been influenced by the nature of your school buildings? What types of building improvements, if any, have impacted (most) upon the behaviour of your pupils?

21 To what extent were these impacts planned for in the building works or were they merely side effects of good design features? Have improvements in pupil behaviour fed through into pupil attainment and, if so, how?

**Parental support [strength = ]**

22 Has parental support been influenced by capital expenditure? If so, what category of building works has had the greatest effect? As appropriate, what aspects of parental support were affected? Have improved buildings attracted parents who then chose your school instead of alternative schools?

23 As regards parents who would traditionally have sent their children to your school, is there any evidence that the degree of parental involvement in their children's education is stimulated by improvements in the buildings or any particular design characteristics or features? Have improvements in the level of parental support fed through into pupil attainment and, if so, how?

**School policies (behaviour, attendance, homework) [strength = ]**

24 Has specific building work undertaken in your school removed constraints on your freedom to adopt best practice in these areas? If so, what category of building works has had the greatest effect and on which school policies? Have changes in school policies fed through into pupil attainment and, if so, how?

**Amount of learning [strength = ]**

25 Has specific building work undertaken in your school freed up more pupil time for learning? What category of building works has had the greatest effect? Have improvements in the amount of learning fed through into pupil attainment and, if so, how?

**Prior pupil attainment [strength = ]**

26 Have building works assisted your school to alter the nature and thereby the quality of the prior attainment of pupils entering the school?

# Appendix B
# Issues in relation to statistical methodology

- Sources of DfEE information on capital spending
- Time lags and causation
- Control group
- Sensitivity analysis – alternative model specifications

## • Sources of DfEE information on capital spending

There are six separate databases held by the Department containing school level information, which potentially could be used in the current study. The databases are (1) School Buildings database, (2) VA Schools database, (3) Funding Agency for Schools (FAS) database, (4) Architects & Buildings (A&B) VA database, (5) Architects & Buildings (A&B) GM database, (6) Building Cost Information Service (BCIS) database.

None of these databases were originally designed for the purpose of assessing the impact of capital spending on pupil performance. Rather, the databases contain information which was originally collected for other, mainly administrative, purposes. This means that there are some important differences between the databases in terms of the nature and extent of the information they contain on capital spending in schools. For example, some of the databases contain information on overall project costs, but not construction costs in particular, whereas others contain information only on construction costs and not overall project costs. Similarly some databases contain only current information, whereas others contain information on projects back to the early 1990s and late 1980s.

These differences mean that, from the point of view of the current study, the databases are limited in some important respects. An important first stage of the study, therefore, involved conducting an assessment of the strengths and weaknesses of these alternative sources of information. Following on from this, recommendations were made about which were the best sources to use from the point of view of the present study. The assessment concluded that, from the point of view of the present study, the most useful sources of information on capital spending in schools are:

- The Architects & Buildings GM Database (GM schools only);
- The Architects & Buildings VA Database and School Buildings database (VA and VC schools only);
- The School Buildings and BCIS databases (County schools only).

## Time lags and causation

### *Capital spend information*

The expectation is that there would be a time lag between the capital investment being made, and its impact on performance being visible. *A priori*, it is difficult to say with any degree of certainty how long this time lag is likely to be. Nevertheless, it was important for the analysis to account for this, to the extent that the available data allowed us to. In order to do this, therefore, the analysis related changes in performance between 1995 and 1999 to capital investment during the preceding three year period (1993-95). The 1993-95 period for capital investment was chosen because, essentially, 1993 was the earliest year for which accurate information on capital spend could be retrieved from the Department's databases. Within this context it is important to note that the information on capital spend relates to tender information. This means that capital spend figures for 1993 mean that the tender for that amount was awarded in 1993. An implication of this is that the actual investment is unlikely to be completed for, say, up to two years after that, depending on the size of the investment.

### *Adequacy of accommodation information*

As outlined above, the information on the adequacy of accommodation has come from the OfSTED inspectors' reports. Most of the OfSTED inspections in relation to the schools on our database were conducted between 1996 and 1998 although, in addition, some were conducted prior to, and after, this time. This means that caution needs to be exercised when interpreting the relationship between the accommodation information and the information on performance change over the 1995-99 period. For example, for those schools where the adequacy of accommodation information relates to 1998-99 it is, in principle, difficult to talk of a causal influence of accommodation on performance since the information on the quality of the capital stock relates to the end of the period over which performance change is assessed. In spite of these difficulties, the adequacy of the accommodation information has been used in the analysis to provide a broad, aggregate indicator of the overall quality of the capital stock during the sample period. In order to ensure that the above-mentioned difficulties with the information do not significantly bias the overall findings, care was taken to estimate the statistical models both with and without the adequacy of accommodation variable (see discussion of 'Sensitivity analysis' overleaf).

### *Information in relation to OfSTED variables*

The information in relation to our sample group is 'snapshot' information, i.e. it relates to an OfSTED inspector's assessment of variables at a certain point in time. This means that when assessing the impact of capital on the OfSTED the Models gave us an assessment of the extent to which capital investment is related to the level of OfSTED variables at a certain point in time; they do not, strictly speaking, enable an assessment of the impact of capital on the extent to which OfSTED variables change in a school, after having received the capital investment. It is also important to note that the information in relation to OfSTED variables is based on the judgements of OfSTED inspectors and as such it is possible, at least in principle, that differences in the subjective judgements of individual inspectors are reflected in the data which, therefore, might be subject to some degree of measurement error.

## Control group

In order to assess the impact of capital spending on performance, it is essential to have information on a sample of schools in which there had been *no* capital expenditure over the relevant time period. These schools essentially represent the 'control group' for the analysis. Information in relation to such a control group was provided by the Analytical Services branch within the Department. The information related to *all* the relevant performance variables and OfSTED variables.

At the outset it is worth highlighting two important issues relating to the control group which has been used in this analysis:

- **Control group in receipt of capital during sample period:** in principle, the control group excludes any school which was in receipt of capital expenditure during the period 1993-95. It is possible, however, that some of the schools in the control group actually *did* receive some capital monies during this period, but that this has not been recorded on the Department's databases. We would expect that this would be the case in relation to County schools more than VA or GM schools, because only relatively large projects are included on the Department's databases for County schools. In order to address this the quantitative analysis was conducted separately for VA, GM and County schools;

- **Control group in receipt of capital outside sample period:** it is important to recognise that, even if a school had no capital expenditure during the 1993-95 period, it may well have had some during an earlier period, say, between 1990 and 1992. If this is the case, then it is possible that the effects of capital expenditure during this earlier period will be 'picked up' in the pupil performance figures we are examining, which relate to the 1995-99 period. If this phenomenon was widespread it would have the effect of reducing the estimated differences in performance between the schools on the database which received capital expenditure during our sample period (1993-95), and those that did not.

In collaboration with the Department an attempt was made to address this issue by trawling the Department's databases in an attempt to identify schools in the 1993-95 control group (i.e. schools which had no capital spending between 1993 and 1995) which did receive capital in the earlier period. Two key points have emerged from this exercise: firstly, on the basis of the Department's databases, only a very small number of schools can be identified which fall into this category (our trawl of VA schools identified 4 primary schools and 2 secondary schools). This highlights the limitations of the existing data in terms of obtaining information on capital projects from the early 1990s and prior to this. Secondly, the schools which fall into this category have a mixed performance record, as compared to the other schools on the database.

## Sensitivity analysis – alternative model specifications

### *Different measures of capital expenditure*

A series of regression models were run based on different measures of capital expenditure:

- Adequacy of accommodation and total capital expenditure per head (1993-95);
- Adequacy of accommodation and *total* capital expenditure (1993-95): I
- Adequacy of accommodation and dummy variables for different thresholds of capital expenditure; two main sets of thresholds were used as follows: (a) none, £1-300 per head, £301-900 per head, and £901-72,000 per head, and (b) none, £1-194 per head, £195-425 per head, £426-794 per head, £795-.1,511 per head and £1,511+ per head.

### *Measuring capital in terms of adequacy of accommodation only*

Model 1 was run by including the adequacy of accommodation variable only as the capital investment measure.

### *Excluding measures of the adequacy of accommodation*

The standard models were run excluding the variable indicating the overall standard of the accommodation. This was done because this information was taken from the OfSTED sources and, as such, significantly reduced the number of eligible cases on our database.

### *Different measures of performance*

A series of regression models were run with differing specifications of the performance variables:

- Proportion changes in performance; here the changes in performance between 1995 and 1999 are specified in proportionate terms;
- Absolute changes in performance; here the changes in performance between 1995 and 1999 are specified in absolute terms, i.e. in terms of a percentage points difference between 1995 and 1999;
- Different time periods; we have examined the change in performance between years other than 1995 and 1999 (e.g. 1995-97 and 1997-99).

### *Filters for regression models*

A series of regression models were run using different sub-groups of the data, including separate models for VA, GM and county schools, separate models which have included only large amounts of capital expenditure (defined as being total expenditure of £200k or more) and separate models which have included only the capital expenditure the category for which is known (i.e. replacements, extensions etc).

### *Different types of models*

All of the regression models presented in this report are based on Ordinary Least Squares (OLS) regression. In addition to this, a series of other models were run including logistic regression models; in these models the performance variables are defined as (1, 0) dummy variables, and have a value of 1 if performance is above average, and a value of 0 otherwise.

# Appendix C
# Detailed statistical results

- **Partial correlation coefficients**
- **Regression 'model 1'**
- **Regression 'model 2'**

## Partial correlation coefficients - capital spending 1993-95 and performance change 1995-99

| 'Controlling-Variable' | KS1 | KS2 | KS3 | GCSE | A Level |
|---|---|---|---|---|---|
| **All Schools** | | | | | |
| ***Free School Meals*** | | | | | |
| Lower third | .153* | -.034 | -.017 | -.015 | .027 |
| Middle third | .067 | .028 | .033 | .050 | .197** |
| Upper third | .174* | .010 | .236** | -.020 | -.051 |
| **Performance level (1995)** | | | | | |
| Lower third | .080 | .000 | .229** | -.021 | .079 |
| Middle third | .082 | -.002 | .079 | .023 | .090 |
| Upper third | -.041 | .051 | -.024 | .017 | .075 |
| **School size (1995)** | | | | | |
| Small | .111 | .002 | .113* | -.040 | -.060 |
| Medium | .119 | -.022 | .169** | .130* | .129 |
| Large | -.076 | .096 | .103 | .024 | .051 |
| ***School type*** | | | | | |
| Selective | . | . | -.113 | -.008 | .140 |
| Other | .091* | .005 | .157** | .003 | .053 |
| **VA Schools** | | | | | |
| ***Free School Meals*** | | | | | |
| Lower third | .118 | -.066 | . | . | . |
| Middle third | .080 | -.126 | . | . | . |
| Upper third | .104 | .004 | . | . | . |
| **Performance level (1995)** | | | | | |
| Lower third | .063 | .025 | . | . | . |
| Middle third | .081 | -.006 | . | . | . |
| Upper third | -.162 | -.011 | . | .056 | . |
| **School size (1995)** | | | | | |
| Small | .107 | -.008 | -.075 | .109 | -.227 |
| Medium | .121 | -.075 | -.199 | .232 | .144 |
| Large | -.132 | -.099 | . | . | . |
| ***School type*** | | | | | |
| Selective | . | . | . | . | . |
| Other | .085 | -.017 | .018 | .199* | .024 |
| **GM Schools** | | | | | |
| ***Free School Meals*** | | | | | |
| Lower third | -.042 | -.043 | -.070 | -.073 | .124 |
| Middle third | . | -.095 | -.078 | -.023 | .085 |
| Upper third | . | . | -.173 | -.084 | . |
| **Performance level (1995)** | | | | | |
| Lower third | . | . | -.086 | -.078 | .006 |
| Middle third | . | .085 | .038 | .109 | .159 |
| Upper third | . | . | .002 | -.048 | .169 |
| **School size (1995)** | | | | | |
| Small | -.087 | -.141 | -.224* | -.087 | -.050 |
| Medium | .130 | -.071 | .050 | -.021 | .096 |
| Large | . | -.022 | -.085 | -.045 | .091 |
| ***School type*** | | | | | |
| Selective | . | . | -.089 | -.031 | .147 |
| Other | -.065 | -.087 | -.050 | -.033 | .031 |
| **County Schools** | | | | | |
| ***Free School Meals*** | | | | | |
| Lower third | .293** | -.021 | .123 | .039 | .004 |
| Middle third | .074 | .113 | .078 | .042 | .306* |
| Upper third | .224* | .011 | .339** | -.027 | -.124 |
| **Performance level (1995)** | | | | | |
| Lower third | .106 | .001 | .328** | -.026 | .157 |
| Middle third | .127 | -.008 | .136 | -.041 | .130 |
| Upper third | .037 | .100 | -.009 | .062 | -.113 |
| **School size (1995)** | | | | | |
| Small | .140 | .030 | .241** | -.063 | -.005 |
| Medium | .127 | -.012 | .220* | .180* | .132 |
| Large | -.054 | .166* | .155 | -.032 | -.108 |
| ***School type*** | | | | | |
| Selective | . | . | . | . | . |
| Other | .114* | .013 | .240** | .003 | .073 |

*Note: A '*' indicates that the sample size in the category concerned was less than 50 and so, on account of statistical reliability, figures for correlations in capital spending and performance are not shown. Correlation coefficients are Pearson's.*

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## Regression model 1: dependent variable – percentage change in performance 1995-1999

| | | Key Stage 1 | | Key Stage 2 | | Key Stage 3 | | GCSE | | A-Level | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | coeff | t | coeff | t | coeff | t | coeff | t | coeff | t |
| | Constant | 117.333 | 18.773 | 180.339 | 15.656 | 69.367 | 5.486 | 66.249 | 4.382 | 77.532 | 4.683 |
| Capital expenditure | Total capital expenditure per head | 0.0004 | 2.191 | -0.0004 | -0.933 | 0.004 | 3.982 | 0.001 | 0.787 | 0.001 | 0.329 |
| | Adequacy of accommodation – above average | -1.349 | -1.189 | 3.916 | 1.621 | 1.424 | 0.672 | 2.119 | 0.761 | -1.307 | -0.430 |
| Background | Performance in 1995 | -1.313 | -26.708 | -2.257 | -27.764 | -1.256 | -12.384 | -1.052 | -8.723 | -5.026 | -11.381 |
| | Free schools meals 1995 | -0.423 | -8.679 | -0.581 | -5.617 | -0.456 | -3.775 | -0.681 | -4.547 | -0.420 | -2.426 |
| | School size 1995 | -0.009 | -1.816 | 0.003 | 0.257 | 0.005 | 1.641 | -0.005 | -1.090 | 0.009 | 1.743 |
| | Class size 1995 | 0.148 | 0.870 | -0.337 | -0.912 | 0.464 | 1.016 | -0.221 | -0.368 | -0.397 | -0.550 |
| | Voluntary Aided | 3.163 | 2.547 | 7.115 | 2.639 | 8.739 | 2.895 | 9.260 | 2.335 | 9.521 | 2.210 |
| | Grant Maintained | 2.477 | 1.408 | 5.116 | 1.411 | 5.861 | 2.464 | 13.755 | 4.421 | 8.722 | 2.658 |
| | County | - | - | - | - | - | - | - | - | - | - |
| | Single sex boys | - | | - | | 10.163 | 2.480 | -0.944 | -0.174 | 4.419 | 0.897 |
| | Single sex girls | - | | - | | 12.577 | 3.166 | 12.485 | 2.426 | 13.116 | 2.594 |
| | Mixed | - | - | - | - | - | - | - | - | - | - |
| | Selective | - | | - | | 22.558 | 4.611 | 25.716 | 3.599 | 25.406 | 4.545 |
| | Other | - | - | - | - | - | - | - | - | - | - |
| | North East | 4.920 | 1.617 | 8.365 | 1.306 | -1.045 | -0.178 | 7.355 | 0.938 | 16.251 | 1.786 |
| | North West | 0.776 | 0.340 | 4.991 | 1.006 | 3.946 | 0.871 | 3.372 | 0.561 | 18.095 | 2.547 |
| | Merseyside | 5.481 | 2.204 | 11.500 | 2.108 | 16.511 | 3.591 | 14.727 | 2.427 | 25.017 | 3.516 |
| | Yorkshire and Humberside | 0.848 | 0.364 | 8.806 | 1.804 | 2.843 | 0.701 | 1.882 | 0.346 | 12.542 | 2.086 |
| | East Midlands | -1.320 | -0.564 | 0.222 | 0.046 | -2.057 | -0.514 | 1.803 | 0.347 | 9.467 | 1.694 |
| | West Midlands | 1.388 | 0.597 | 8.079 | 1.635 | 1.852 | 0.486 | 4.229 | 0.846 | 12.463 | 2.243 |
| | South West | 0.027 | 0.013 | -2.783 | -0.618 | 0.690 | 0.174 | 2.971 | 0.560 | 14.221 | 2.416 |
| | Eastern | 2.297 | 1.046 | 5.526 | 1.213 | -4.210 | -1.188 | 2.581 | 0.548 | 4.560 | 0.904 |
| | Inner and Outer London | 3.052 | 1.167 | 15.943 | 2.967 | 3.845 | 1.016 | 7.366 | 1.492 | 0.665 | 0.128 |
| | South East | - | - | - | - | - | - | - | - | - | - |
| | % absences 1995 | 0.005 | 0.102 | -0.132 | -1.136 | -2.448 | -2.995 | 2.090 | 1.916 | -2.816 | -2.111 |
| Diagnostics | n | 650 | | 723 | | 612 | | 639 | | 381 | |
| | $R^2$ | 55.5 | | 58.7 | | 33.3 | | 19.2 | | 32.8 | |
| | F | 43.7 | | 55.7 | | 14.0 | | 7.0 | | 8.3 | |
| | Average value of dependent variable | 7.9 | | 38.7 | | 13.1 | | 17.0 | | 16.2 | |

*Note: Class size in 1995 is defined as the average class size in 1995 for 1 teacher classes.*

## Regression model 2: dependent variable – percentage change in performance 1995-1999

| | | Key Stage 1 | | Key Stage 2 | | Key Stage 3 | | GCSE | | A-Level | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | coeff | t | coeff | t | coeff | t | coeff | t | coeff | t |
| | Constant | 113.951 | 17.837 | 168.583 | 14.175 | 59.264 | 3.545 | 70.879 | 3.244 | 80.574 | 4.213 |
| Capital expenditure | Total capital expenditure per head | 0.0003 | 1.917 | -0.001 | -1.386 | 0.003 | 2.550 | 0.001 | 0.528 | 0.001 | 0.577 |
| | Adequacy of accommodation – above average | -2.102 | -1.778 | 2.166 | 0.866 | -1.341 | -0.473 | -2.416 | -0.613 | -1.407 | -0.414 |
| Background | Performance in 1995 | -1.341 | -26.774 | -2.277 | -27.602 | -1.229 | -9.294 | -1.327 | -8.154 | -4.797 | -10.220 |
| | Free schools meals 1995 | -0.391 | -7.782 | -0.505 | -4.742 | -0.105 | -0.608 | -0.496 | -2.196 | -0.645 | -2.877 |
| | School size 1995 | -0.011 | -2.081 | 0.001 | 0.106 | 0.0003 | -0.073 | -0.008 | -1.186 | -0.001 | -0.232 |
| | Class size 1995 | 0.137 | 0.797 | -0.315 | -0.856 | 0.123 | 0.211 | -0.244 | -0.294 | -0.867 | -1.085 |
| | Voluntary Aided | 3.612 | 2.912 | 7.267 | 2.713 | 1.372 | 0.297 | 6.889 | 1.064 | 11.976 | 2.056 |
| | Grant Maintained | 2.286 | 1.293 | 4.605 | 1.273 | 0.064 | 0.018 | 8.656 | 1.727 | 6.387 | 1.377 |
| | County | - | - | - | - | - | - | - | - | - | - |
| | Single sex boys | - | - | - | - | 4.035 | 0.868 | 1.240 | 0.188 | 2.423 | 0.475 |
| | Single sex girls | - | - | - | - | 6.296 | 1.342 | 10.727 | 1.684 | 2.940 | 0.570 |
| | Mixed | - | - | - | - | - | - | - | - | - | - |
| | Selective | - | - | - | - | 24.839 | 4.513 | 36.651 | 4.254 | 23.537 | 4.202 |
| | Other | - | - | - | - | - | - | - | - | - | - |
| | North East | 5.027 | 1.657 | 6.856 | 1.078 | -3.318 | -0.323 | 15.171 | 1.044 | 30.900 | 2.285 |
| | North West | 0.925 | 0.406 | 6.153 | 1.251 | 4.152 | 0.677 | 2.108 | 0.244 | 18.869 | 2.602 |
| | Merseyside | 6.034 | 2.414 | 9.946 | 1.821 | 19.936 | 3.325 | 10.574 | 1.274 | 17.097 | 2.092 |
| | Yorkshire and Humberside | 0.831 | 0.358 | 8.736 | 1.800 | 6.609 | 1.171 | -0.013 | -0.002 | 16.737 | 2.490 |
| | East Midlands | -0.169 | -0.072 | 2.415 | 0.509 | -1.271 | -0.276 | -1.196 | -0.187 | 12.900 | 2.198 |
| | West Midlands | 2.130 | 0.909 | 7.842 | 1.595 | -0.098 | -0.021 | 3.307 | 0.506 | 12.457 | 2.157 |
| | South West | -0.152 | -0.072 | -1.626 | -0.364 | 1.360 | 0.280 | -2.893 | -0.420 | 15.045 | 2.415 |
| | Eastern | 2.101 | 0.960 | 5.821 | 1.293 | -1.366 | -0.324 | 1.160 | 0.195 | 12.402 | 2.327 |
| | Inner and Outer London | 3.173 | 1.220 | 16.966 | 3.185 | 2.930 | 0.605 | 3.248 | 0.493 | 8.923 | 1.626 |
| | South East | - | - | - | - | - | - | - | - | - | - |
| | % absences 1995 | 0.012 | 0.230 | -0.161 | -1.397 | -2.093 | -1.481 | 0.757 | 0.379 | -1.750 | -0.903 |
| Intermediate | Quality of teachers – above average | 2.605 | 2.033 | -1.870 | -0.686 | -0.106 | -0.035 | -5.754 | -1.335 | 10.951 | 2.904 |
| | Adequacy of resources – above average | -0.197 | -0.148 | 8.145 | 2.856 | 0.451 | 0.162 | 8.675 | 2.227 | 0.337 | 0.103 |
| | Leadership – above average | -0.400 | -0.309 | -5.599 | -1.979 | 7.533 | 2.148 | 8.002 | 1.648 | 2.331 | 0.535 |
| | School ethos – above average | 1.731 | 0.944 | 3.251 | 0.827 | 1.617 | 0.356 | 3.828 | 0.607 | -7.455 | -1.429 |
| | Parental involvement – above average | -0.192 | -0.153 | 0.635 | 0.238 | 0.863 | 0.317 | 8.783 | 2.329 | 3.739 | 1.199 |
| | Attitudes – above average | 0.210 | 0.092 | -7.853 | -1.607 | 6.378 | 1.352 | 8.338 | 1.266 | 1.146 | 0.207 |
| | Behaviour – above average | 1.714 | 0.866 | 6.675 | 1.587 | 7.025 | 1.531 | 10.165 | 1.590 | -3.851 | -0.738 |
| | Relationships – above average | 2.024 | 0.858 | 13.450 | 2.745 | 4.772 | 0.803 | -17.163 | -2.056 | 9.679 | 1.255 |
| | Change in school size 95-99 | 0.035 | 2.393 | 0.008 | 0.243 | -0.0002 | -0.013 | 0.048 | 2.867 | 0.014 | 0.951 |
| Diagnostics | n | 647 | | 719 | | 365 | | 381 | | 252 | |
| | $R^2$ | 56.9 | | 60.7 | | 44.5 | | 29.3 | | 41.1 | |
| | F | 30.2 | | 39.6 | | 8.9 | | 4.8 | | 5.1 | |
| | Average value of dependent variable | 7.9 | | 38.7 | | 13.1 | | 17.0 | | 16.2 | |

*Note: class size in 1995 is defined as the average class size in 1995 for 1 teacher classes.*

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